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ABSTRACT

Presented is the fourth in a series of formative evaluation reports on "Me and My Environment", a 3-year environmental sciences program for 13- to 16-year-old educable mentally handicapped (EMH) children. The rationale and standards for monitoring instructional effectiveness are explained, and student performance is reported on field tests of items assessing instruction in Units 1 ("Exploring My Environment"), 2 ("Me as a Habitat"), and 3 ("Energy Relationships in My Environment"). Described is a small-scale field test in which techniques of observing, describing, comparing and ordering objects were taught to 14 EMH students through the use of stereograms and viewers. Discussed are the implications for curriculum development of a survey of 235 EMH adolescents concerning their attitudes toward and use of tobacco, alcohol, and unprescribed drugs. Four abstracts of studies on the functional abilities of EMH students are provided, and comments are offered relating findings about cognitive abilities and students' manipulative skills to curriculum development. (LH)

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Me and My Environment

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FORMATIVE EVALUATION REPORT

4

Assessing student abilities and performance: year 2

May 1975

Prepared by
Roy O. Gromme

BIOLOGICAL SCIENCES CURRICULUM STUDY

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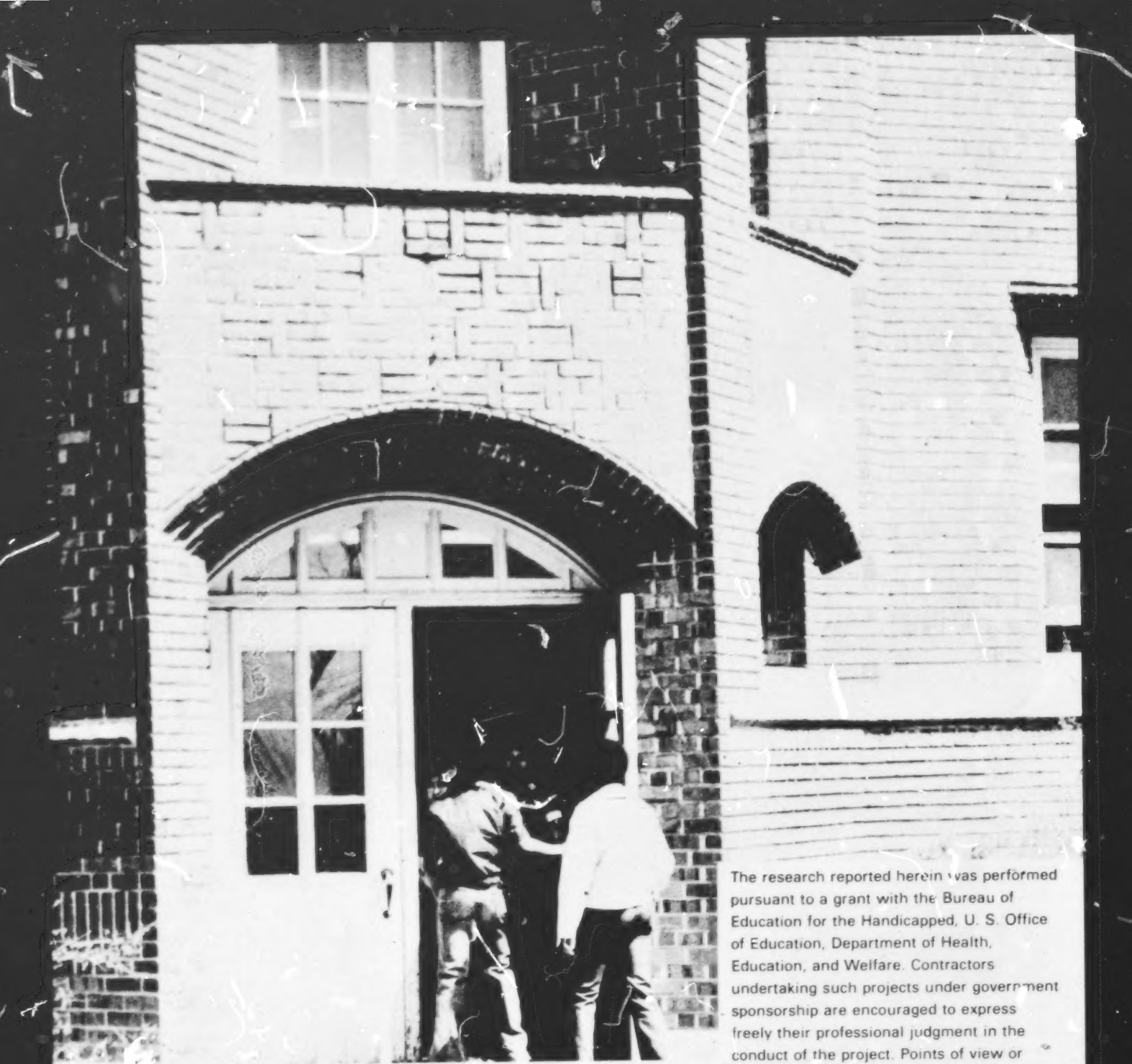

ME AND MY ENVIRONMENT

FORMATIVE EVALUATION REPORT 4

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the context for this report

The Curriculum

ME AND MY ENVIRONMENT is a three-year environmental sciences program developed specifically for 13- to 16-year-old educable mentally handicapped (EMH) children.[1] Its development and assessment, the actual materials and their use in the classroom, the approaches to data collection, and the student outcomes all merit evaluative study. Such activities might best be viewed in the context of the three-year timeline for the development, testing, and final commercial release of the first two-year sequence (Units 1-3) of the program. During this period the third-year (Units 4 and 5) sequence was developed and tested with an additional year and one-half devoted to the final evaluation and revision for commercial release.

So that ME AND MY ENVIRONMENT could be used in special education classes as soon as possible, the field trials were designed to overlap; two complete field tests of the materials were accomplished in three school years.

The materials for ME AND MY ENVIRONMENT include a series of teacher's manuals that suggest specific teaching strategies for each activity. Also included is a kit of all equipment, media, and supplies that are required for the instructional program, but not usually available in special

education classrooms. There is no student text, for the program is designed around activities that are conducted by the students themselves; these activities are supported by a variety of multisensory and multimedia instructional materials, that is, materials in a number of different media designed to appeal to two or more different senses of the students. Some of these materials, in addition to science equipment in the kit, consist of 35mm slides, filmstrips, cassette tapes, individual student worksheets, games, posters, study cards, wall charts, illustrated booklets, and evaluative devices. The program makes use of a 35mm slide projector and an overhead projector. In addition, the students' direct involvement with a Polaroid camera and a cassette tape recorder has been tested.

The serious reader of this report will likely have reviewed, or have access to, the teacher's manuals for ME AND MY ENVIRONMENT. For that reason, information on the curriculum objectives, science content, and skill development will not be described here. (Refer to the front material in any unit of the manuals for this information.)

The development of this project and its evaluation are based upon three years of experience in developing and field-testing ME NOW, a life science curriculum for 11- to 13-year-old EMH children.[2] The ME NOW program and the first two years of ME AND MY ENVIRONMENT are now available in commercial editions from Hubbard Scientific Company, Box 105, Northbrook, Illinois 60062. Several evaluation reports on these programs have been prepared. (Refer to the bibliography at the end of this section.)

The Evaluation

Because the evaluation effort for this program is truly formative—an assessment designed to direct revision—the information gathered is utilized by the developers whenever the material that has been tested is revised. One might think, therefore, that there is little point in preparing formal evaluation reports based on this formative data. Yet the experience gained and some of the outcomes of the evaluation have been found to have value to other audiences. Such information is judged not only worth preserving, but also of a sufficiently general application that the timeliness of reporting it becomes a concern. It has been decided, therefore, to issue this series of interim evaluation reports. Several cautions to the reader of these interim reports are necessary in order to avoid misinterpretations of the findings.

1. The interim reports document results with experimental materials, and therefore do not present a balanced view of the program finally released for commercial publication.
2. The interim reports identify changes to be made, but do not reflect all the changes incorporated into revised materials.
3. The interim reports do not provide a synthesis that enables one to draw a balanced judgment of the entire program.

A description of the contents of the first three ME AND MY ENVIRONMENT reports in this series is given on page 3 of *Formative Evaluation Report 3*. Only a limited number were printed, but copies are on file at all special education instructional materials centers and are available from the Educational Resources Information Center (ERIC) networks Document Reproduction Service (EDRS).[4] Abstracts have been published by the CEC Information Center in its capacity as the ERIC Clearinghouse on Handicapped and Gifted Children.[5]

Formative Evaluation Report 4: Student Performance on Revised Materials, and Another Look at Student Abilities. This report serves four purposes:

1. It describes the standards for judging the success of instruction and of the materials, and presents a new approach to the assessment of student performance.
2. It reports on student performance related to instruction in a second series of field trials of revised Units 1, 2, and 3, and compares the results to those of the first trials.
3. It analyzes the relationship of measured abilities, performance, and various other variables utilizing the techniques of multiple regression.
4. It draws attention to certain implications of these findings for special education. ■

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[1] *ME AND MY ENVIRONMENT (Life Sciences: A Special Education Program). Unit 1: Exploring My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1974.

———. *Unit 2: Me as an Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1974.

———. *Unit 3: Energy Relationships in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1975.

———. *Unit 4: Transfer and Cycling of Materials in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1973 (Second Experimental Edition).

———. *Unit 5: Air and Water in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1973 (Second Experimental Edition).

[2] *ME NOW, Life Sciences: A Special Education Program.* Boulder, Colorado: Biological Sciences Curriculum Study. 1972.

[3] Robinson, James T. and Richard R. Tolman. *A Formative Evaluation of ME NOW, Unit 1, Digestion and Circulation.* Boulder, Colorado: Biological Sciences Curriculum Study. September 1970. 97 pp. (ED 043182) (EC 030165)

Steele, Joe M. *Arranging Field Tests: Characteristics of Sites and Students. ME AND MY ENVIRONMENT Formative Evaluation Report 1.* Boulder, Colorado: Biological Sciences Curriculum Study. June 1973. 29 pp (ED 087190) (EC 061292)

———. *Assessing Student Abilities and Performance: Year 1. ME AND MY ENVIRONMENT Formative Evaluation Report 2.* Boulder, Colorado: Biological Sciences Curriculum Study. December 1973. 48 pp. (ED 087191) (EC 061293)

———. *Design and Revision, Data Collection and Portrayal. ME AND MY ENVIRONMENT Formative Evaluation Report 3.* Boulder, Colorado: Biological Sciences Curriculum Study. September 1974. 53 pp. (ED 100123) (EC 071063)

Tolman, Richard R. *A Formative Evaluation of ME NOW, Life Sciences for the Educable Mentally Handicapped, Final Report.* Boulder, Colorado: Biological Sciences Curriculum Study. December 1972. 305 pp. (ED 071263) (EC 050871)

[4] ERIC Document Reproduction Service, P. O. Box 190, Arlington, Virginia 22210.

[5] CEC Information Center, 1920 Association Drive, Reston, Virginia 22091.

a revised means of monitoring the effectiveness of instruction (clues to success: rationale and standards)

Research studies have established that teacher expectancy directly affects student achievement, not only in classes for the educable mentally handicapped (EMH), but in almost all other classes as well. Because teacher expectancy has quite often been low for EMH students, and because teaching materials in science have no traditional or essential place in the curricula for these students, designing test items that field-test teachers could administer to their classes with confidence became a special problem to the curriculum developers.

It had been demonstrated during the formative evaluation of ME NOW that EMH children could respond appropriately to four choices in a pictorial format that contained a minimum of written material. The design and many examples of such items were elaborated in *Formative Evaluation Report 1*, along with the background of their development and the data that were obtained from their trial use. For Field Test I the items were grouped in identical pre- and posttests, for administration preceding and following each unit of instruction. Included in each test were items specifically designed to secure information on student baseline knowledge, inquiry skills, problem-solving ability, functional ability, and understanding of environmental themes. The items were also designed to secure data about how successful the students had been in achieving objectives, and what their interest level had been. Procedures were devised to assure that students were not penalized for reading difficulties: the items were read to them by their teachers as they followed along in their test item booklets, and measures were included to make sure that all students were attending to the same test item at a given time during administration of the test. This is a departure from what was done during the evaluation of ME NOW where, in addition to the above, each question was duplicated on a 35mm slide and projected on a screen during the test for added reference. The items were not intended as tests for grading, nor were they used that way to evaluate youngsters.

The use of pre- and posttesting in a formal achievement testing framework provided considerable information, as *Formative Evaluation Report 2* indicates. This testing format, however, proved to be of little value to the writers who revised the materials, for a relatively small number of items were tied to individual activities; most were tied to large sequences of instruction. In addition, the items were costly to develop, time-consuming to analyze, and results were often incomplete at the time revision took place. For these reasons, therefore, and because baseline data on the students and their functional abilities had been obtained in the first year of field-testing, a different format was planned for obtaining performance data in the second year—a format that would serve both the needs of the current formative evaluation as well as those of the teacher, once the program became commercial.

Thus, in the fall of 1972, with the first field test of the second edition of Unit 2, "Me as a Habitat," a number of situational tasks and minitests were incorporated into the Teacher's Instructional Manual. These were designed to provide immediate feedback on student understanding as well as on the effectiveness of materials and instruction. At whatever point in the curriculum each of these activities was used, teachers would have the opportunity to determine whether their students were ready for the next activity, or whether modification, repetition, extension, or review of certain activities was necessary before proceeding. These short evaluative activities were also useful to the project staff in providing feedback directly related to specific activities. This valuable data was used in making specific recommendations for the revision of activities, cores, and units.

The pilot test of the new approach was judged successful. It was consequently decided to drop the achievement test pre- and posttest format. Instead, for Field Test II, data was collected at the time or shortly after the concepts were taught. Instructional assessments were developed for short sequences of activities throughout the entire set of curricular materials. These assessments were developed as activities in themselves, and in many cases they involve practical applications or actual performance tasks rated by the teacher. They include a tallysheet for compiling information on each student, or for making the ratings of performance. Instructions to the teacher explain how to interpret and use the materials. The tallysheets, and in some cases the student worksheets themselves, were sent to the BSCS and used as the source of data on student performance.

For the three units of instruction that have so far been released for publication, nearly 100 assessment items were developed; three-fourths of these can be scored for individual students, while the remainder are used to make judgments about classroom groups of students. These assessment activities were given the title "Clues to Success." They appear

periodically after a cluster of similar activities, at the end of each core of a unit, and as summarizing or review activities at the conclusion of each unit. An effort has been made to present them to the teacher as a means of determining which students are successful with the materials and ready to proceed to the next level of instruction and which students have not met the minimum criteria and therefore need additional help. They are not presented as a way of grading the students. It is felt that the assessment activities reinforce a student success syndrome.

The data collected from "Clues to Success" did in fact provide the revision team of writers with specific performance information related to each activity or small cluster of activities. Also, as indicated in teacher feedback reports, the assessment activities were of great value in guiding teachers in planning and monitoring instruction, both for the entire class and for individual students. From that data and feedback, it has been concluded that changing from the pre- and posttest format used in Field Test I significantly improved the quality of the materials. The "Clues to Success" format that was used in Field Test II was, however, a major departure from the evaluation technique used in Field Test I. There were, as a result, a number of trade-offs of data, both qualitatively and quantitatively. It is acknowledged that the "Clues to Success" assessment activities that were used in Field Test II have certain shortcomings as an evaluative device:

1. They do not provide data on the long-term retention of knowledge and understanding. Since the "Clues to Success" activities were interspersed as they were, soon following instruction, they became an immediate check on knowledge and understanding, but not a long-term one.

2. They do not make data collection simple and easy. Because data is collected at many points throughout the school year rather than at the beginning and end, a host of problems are created. The most signficant of these are student absenteeism, less control over testing conditions, and a potential deviation from uniformity because the scoring and coding is done by the teachers themselves.

However, the "Clues to Success" short-term assessment items used in Field Test II and the commercially published editions provide the following advantages:

1. Immediate feedback on the effectiveness of the materials and instruction. At the point of use of each of the "Clues to Success" activities, the teacher can determine whether or not his or her students are ready for the next activity, or whether modification, repetition, extension, or review of certain activities is necessary before proceeding.
2. Assessment directly related to specific activities. Valuable feedback and recommendations for revisions of activities, cores, and units are thus available.
3. Opportunities for the teacher to monitor the *individual* progress of each student and set different standards of success for different youngsters. Because some youngsters may do well in some units and not so well in others, the "Clues to Success" enable the teacher to adjust assessments of each student as the year goes on.

Standards for acceptable student performance were established by BSCS staff members and evaluators on the "Clues to Success" objective questions and situational tasks. It should be noted that these standards were not attempts to predict actual performance on the items. In fact, quite the contrary. The staff worked hard to assure that expected outcomes would not be a basis for establishing standards. Instead, two questions were continually asked: "How *central* is this particular item or subtest of items to the major goals, aims, and objectives of the ME AND MY ENVIRONMENT curriculum materials?" and, "What level of performance, in terms of percentage of students responding correctly on the items, can we accept as not requiring revision of the activities involved?" Because individual assessment items were included in the "Clues to Success" for a number of reasons, the spectrum of standards ranges from 85 percent for the more central ones to a low of 25 percent for those less central. Some assessment items were aimed at securing data to determine directly the effects of the materials and/or instruction, while other items were aimed at finding out how much more beyond certain basic levels students had been able to learn. ■

Summary of ME AND MY ENVIRONMENT Editions Correlated with Field Tests

First Experimental Edition	Second Experimental Edition	Commercial (Final) Edition
UNIT 1: Untitled (1971-72, Field Test I)	UNIT 1: Exploring My Environment (1972-73, Field Test II)	UNIT 1: Exploring My Environment, 1974
UNIT 2: Part 2, Untitled (1971-72, Not field tested)	UNIT 2: Me as a Habitat (1972-73, Field Tests I and II)	UNIT 2: Me as an Environment, 1974
UNIT 2: Part 1, Untitled (1971-72, Field Test I)	UNIT 3: Energy Relationships in My Environment (1972-73, Field Test II)	UNIT 3: Energy Relationships in My Environment, 1975
UNIT 4: Transfer and Cycling of Materials in My Environment (1972-73, Field Test I)	UNIT 4: Transfer and Cycling of Materials in My Environment (1973-74, Field Test II)	UNIT 4: Transfer and Cycling of Materials in My Environment, 1976
UNIT 5: Air and Water in My Environment (1973-74, Field Test I)	None	UNIT 5: Water and Air in My Environment, 1976

student performance on items assessing instruction in unit 1, "exploring my environment," field test II

For Field Test II, sixty-two items assessed curricular materials and instruction in the seventy-three activities of Unit 1, "Exploring My Environment," Unit 3, "Energy Relationships in My Environment," (revised from Unit 2, part 1, 1971-72 first experimental edition), and Unit 2, "Me as a Habitat," (revised from Unit 2, part 2, 1971-72 first experimental edition).

While Field Test I data were collected on identical pre- and posttests and administered preceding and following each unit of instruction, Field Test II data were collected from "Clues to Success" activities that were incorporated in each unit and administered at various intervals immediately following instruction.

The population from which data were analyzed for Field Test II consisted of seventeen classes containing 197 EMH students. On some subtests, however, because of student absenteeism in some cases and disqualification of data in others, the population was considerably less than 197. Data was disqualified when in the judgment of the BSCS staff it appeared that certain teachers provided too much direction to their students, and as a result, nearly every student responded to the assessments in the same way.

Twenty-two of the sixty-two items directly related to materials and instruction in Unit 1. The twenty-two items assessed materials and instruction presented in the twenty-nine activities of the revised unit, and the items fell into six categories by topic: 1) Environmental Comparisons; 2) Temperature, Estimation, and Measurement; 3) Grouping and Classifying; 4) Spatial Orientation; 5) Specific Information; 6) Picture Taking. Although the results are presented by these content topics, the items were interpreted separately rather than as subtest scores.

Results are presented with a brief discussion of each item, percentages of students responding successfully, comparisons to establish standards as discussed in "Clues to Success," where possible and appropriate, comparisons to similar or identical assessments made in Field Test I, and a brief analysis and explanation of revisions and expansions and/or deletions that took place in the commercial version as a result of student performance on these assessments. In addition, there is discussion on twelve assessment items given to students at least three months after instruction on Unit 1 to measure long-term retention.

The percentage of successful responses on the earlier ME NOW test items was characteristically at the 50 percent level. In that study many students had reasonable and logical explanations for choosing options other than the intended answers to many items; hence, the level of understanding was not totally reflected in the percentage of students choosing the "right" answer. A similar condition also has occurred in the ME AND MY ENVIRONMENT assessment. In fact, 40 percent of the Unit 1 test items have a qualitative scoring key, with some responses given credit as partially correct. The reasons for choosing other "answers" provide a separate justification for inspecting each item separately.

The problem of assessing the learning of EMH students is not resolved by producing an "achievement test," since the question of what standard to apply to performance on these items or subtests is one that is difficult to answer. It is unrealistic to expect all children to be able to answer all items, when a wide range of difficulty and a range of topics are involved. Answering successfully even one or two items more on Field Test II than on Field Test I may represent considerably improved materials and, therefore, significantly more learning for some students. The items represent the staff's judgment of key content that should be learned, *not* all learning that can be expected to occur in instruction. Some areas of learning were not assessed at all; others were explored only through interviews and are not reported here. Notably absent are measures of observation skills and problem-solving skills that are directly related to the materials. Students' attitudes also are not reflected here, although measures are reported elsewhere. The effects of this curriculum on self-confidence, social participation, task orientation, and general response to school have not been formally assessed.

Efforts were made from the beginning to assure that use of the items in different classes would be comparable. The "Clues to Success" activities were administered by the teachers, using identical instructions. Some training was provided at the beginning of the school year, and additional written instructions were sent. Even with these precautions, however, conditions and procedures could not be standardized.

The test items themselves were undergoing their second field test. Individual interviews with students were conducted to validate certain items, and, as a result, approximately 30 percent of the original number of items were eliminated or significantly revised. Undiscovered weaknesses may remain in some of the twenty-two items retained for analysis.

It should be noted that student performance on these selected assessments was only one vehicle used in evaluating the ME AND MY ENVIRONMENT curriculum materials. Student interviews, teacher ratings, independent evaluators, and classroom observations were all used extensively to provide additional input to the curriculum developers.

However, these test items do represent the best judgment of the staff as to key concepts to be learned in the materials. Even though the results should not be used as a summative evaluation of student learning, they do provide a clue to the degree of learning that occurred. Combined with the information on the functional abilities of this population, expectations of student response can be readjusted, and revisions designed to enhance further learning.

Prior to field-testing, the staff established standards of acceptable student performance for the various objectives and assessments. In some cases these standards were based on hard data, but often they were intuitively based on such factors as a general knowledge of the population, the importance of

the item, and the experience of a normal population of students with similar items.

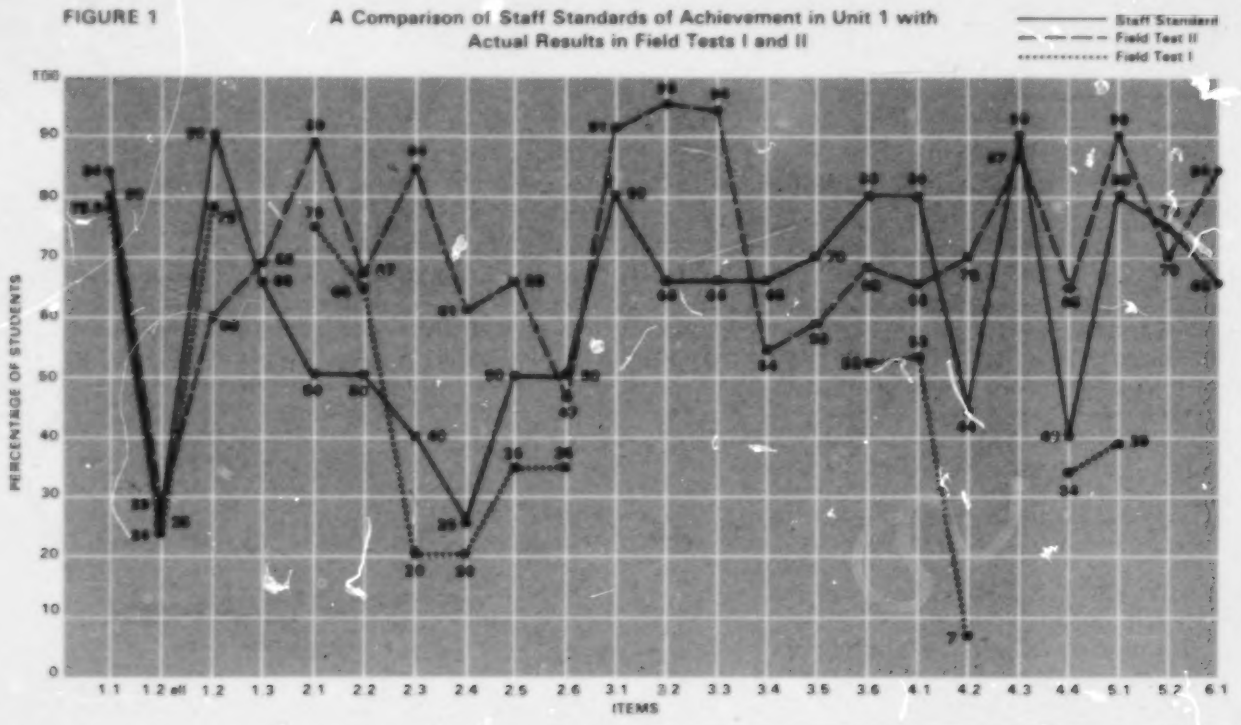
Some of the items assess learning that goes beyond the achievement of minimal objectives. Since the curriculum is designed to allow the students in a typical EMH group to progress as far beyond the minimal standards as possible, some items were meant to assess what learning took place above the minimum. Hence the performance standards do vary from 25 percent up to 90 percent. Upon studying the reliability and other analysis factors of the items, the staff compared the standard to the actual achievement and sought answers to the questions raised by proceeding in at least one of four ways: to analyze the item for clarity or unwanted cues; to relate the item to instruction; to look at the instruction related to the objective; to look at the objective itself. Based upon this introspection, the standard was deemed realistic or unrealistic, instruction adequate or inadequate, or the objective appropriate or inappropriate.

The staff found it of interest that in eighteen of the twenty-three cases in the second experimental edition of Unit 1, (Field Test II) the students did achieve at or above the standard. Of the fourteen similar but not necessarily identical items in the first experimental edition of Unit 1 (Field Test I) all but two were lower than the results of Field Test II. This reflects an improvement in the materials as well as in the items between the two field tests.

A summary of results from the use of the test items follows. (See Figure 1.)

FIGURE 1

A Comparison of Staff Standards of Achievement in Unit 1 with Actual Results in Field Tests I and II



Unit 1, Subtest 1, "Environmental Comparisons"

Table 1 contains a statistical summary of three assessment items used as Subtest 1, "Environmental Comparisons." These assessments were administered as Activity 1-12 on Tallysheet 1-1 in Core A, Unit 1, "Exploring My Environment," second experimental edition, 1972-73. Table 1 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was seventeen points; four points for assessment 1, eight for assessment 2, and five for assessment 3.

Assessment 1 deals with the relationship between our senses and the environment about us. The data reveals that 79 percent of the students responded successfully to the items, compared to the BSCS staff standard of acceptability of 80 percent. Statistically, 79 percent is within the acceptable

TABLE 1

Summary Information for Subtest 1
"Environmental Comparisons"
(three items)

This group of items assessed ability to

- identify which of the senses respond to specific environmental stimuli (Item 1)
- recognize that a variety of concrete and intangible elements can form part of the environment (Item 2)
- understand the relationship between an animal and its environment (Item 3)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G	H
1	0	0	0	4	-	-	-	-
2	1	1	1	1	1	1	1	1
3	0	5	0	0	0	0	-	-

Subtest Statistics

Maximum Possible Score: 17
Range of Scores: 3-17
Number of Students: 144
Mean: 9

range. In the identical assessment that was used in Field Test I, 84 percent of the students responded successfully, slightly above the acceptable standard.

1-1.

STUDY THE FOLLOWING LIST:

FIRE SIREN
TRAIN WHISTLE
JET AIRPLANE
ROCK MUSIC
SEA SHORE

WHICH WOULD BEST HELP YOU TELL IF ALL OF THESE WERE PART OF YOUR ENVIRONMENT?

A **4%** B **4%** C **7%** D **79%**

MARK AN X ON YOUR CHOICE.

Multiple Response = 4% **No Response = 21%**

Assessment 2 measures student recognition of some components of the environment. All eight choices are correct, and 28 percent of the students successfully selected all eight. Four or more of the responses were selected by 60 percent of the students. BSCS staff standards were for 25 percent of the students to select all and 90 percent to select four or more of the choices. This same question was used in Field Test I, but with fourteen choices instead of eight. The choices were reduced by six in Field Test II in order to correlate more closely with the instructional materials. In Field Test I, 24 percent of the students selected all of the correct responses and 78 percent selected four or more. Overall student performance on this assessment was better in Field Test I than in Field Test II.

1-2.

(Refer to Item 13, page 35, *Formative Evaluation Report 2*)

MARK AN X ON EACH THING THAT COULD BE A PART OF THE ENVIRONMENT.

A. SMOKE	B. MUSIC	C. GARBAGE	D. FLOWERS
60%	**67%**	**55%**	**69%**

E. PEOPLE	F. CLOUDS	G. SMELLS	H. ANTS
75%	**59%**	**76%**	**58%**

No Response = 4%

Assessment 3 asks students to select an animal as a poster theme and to include in the poster the environmental components that are important to the animal's well-being. An accurate understanding of the relationship between an animal and its environment with a listing of five key components (food, shelter, etc.) essential to the animal's environment was demonstrated by 39 percent of the students. Thirty percent of the students were able to select three or four essential components, and 31 percent selected only one or two components. The selection of three or more essential components by 66 percent of the students was set as a standard by the BSCS staff. Student performance slightly exceeded this standard. There was no appropriate assessment for comparison in Field Test I.

In referring to the table on page 26 of *Formative Evaluation Report 3*, it can be seen that the activities in Unit 1 were considerably revised before the unit was released for commercial publication. To mention only a few of the more extensive revisions, the environmental activities were moved to Core C so that more science would be presented before environmental relationships were introduced; the Environmental Rummy game was expanded, improved, presented in four-color art, and offered in smaller sequential steps.

Unit 1, Subtest 2, "Temperature, Estimation and Measurement"

Table 2 contains a statistical summary of six assessment items used as Subtest 2, "Temperature, Estimation and Measurement." These questions were administered as Activities 1-20, 1-21, and 1-22 on Worksheet 1-10 and Tallysheet 1-3 in Core B, Unit 1, "Exploring My Environment," second experimental edition, 1972-73. Table 2 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was twenty-two points, five points each for assessments 1, 2, 5, and 6, and one each for assessments 3 and 4.

Assessment 1 measures student ability to read within ± 2° F a thermometer placed in a beaker of water. The

TABLE 2

Summary Information for Subtest 2
"Temperature, Estimation and Measurement"
(six items)

This group of items assessed ability to
- read a thermometer (Item 1)
- differentiate between groups of temperatures taken indoors and outdoors (Item 2)
- estimate length (Items 3 & 4)
- measure length accurately (Items 5 & 6)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G
1	5	0	-	-	-	-	-
2	5	0	-	-	-	-	-
3	1	0	0	0	0	0	0
4	1	0	0	0	0	0	0
5	5	0	0	0	0	0	0
6	5	0	0	0	0	0	0

Subtest Statistics:

Maximum Possible Score: **22**
Range of Scores: **2-22**
Number of Students: **143**
Mean: **12**

thermometer was shifted between beakers containing water at varying temperatures to prevent students from exchanging information. Results show 89 percent of the students were successful on this item, compared to a 50 percent standard of acceptability. In Field Test I, 75 percent of the students were successful with the activity. It is interesting to note that EMH students compared most favorably with "average" youngsters on this assessment.

Assessment 2 evaluates student ability to differentiate between two groups of temperatures—one group taken inside and one outside. Results indicated that 67 percent of the students responded successfully, compared to the 50 percent staff-established standard. An item assessing the same objective, but by means of a line graph instead of a table, was used in Field Test I, where 65 percent of the students responded successfully.

2-2.

(Refer to Item 20, page 33, *Formative Evaluation Report 2*)

BELOW ARE RECORDS OF THE TEMPERATURE TAKEN FIVE DAYS IN A ROW IN TWO DIFFERENT PLACES. ONE SHOWS THE TEMPERATURE OUTSIDE OF A SCHOOL HOUSE. THE OTHER SHOWS THE TEMPERATURE IN A CLASSROOM.

OCT.	4	5	6	7	8
X	58	65	74	68	79

A
67%

OCT.	4	5	6	7	8
	70	71	72	71	74

B
30%

MARK AN X ON THE RECORD THAT SHOWS THE OUTSIDE TEMPERATURES.

Multiple Response = 2% No Rating = 1%

Assessments 3 and 4 test student ability to estimate the length of two pieces of paper strips, one measuring 3½ inches and the other 18 inches. The students who estimated the 3½-inch strip to be between 1 inch and 6 inches in length constituted 84 percent of those tested. Of these, 79 percent estimated it to be between 3 and 4 inches. The staff had established a standard of 40 percent within the 1-inch and 6-inch range. The students who estimated the 18-inch strip to be between 12 inches and 24 inches in length constituted 61 percent. In this case, the staff had established a standard of 25 percent. In Field Test I, an estimation assessment asked students to predict how many paces were in 10 feet. Less than 20 percent of the students responded successfully. In another assessment students were asked to guess and then try to determine the distance between two points 15 feet apart. Thirty-one percent were successful at this.

2-3 and 2-4.

(Refer to Items 7, 41, and 42, page 31, *Formative Evaluation Report 2*)

GUESS THE LENGTH OF THE SHORT AND LONG STRIPS OF PAPER. WRITE YOUR GUESSES ON THE LINES BELOW.

SHORT STRIP LONG STRIP

MY GUESS: _____ INCHES. MY GUESS: _____ INCHES.

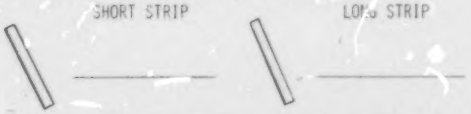
Assessments 5 and 6 test student ability to measure accurately within ¼ inch the 3½-inch and 18-inch strips of paper. Over 66 percent of the students were successful with the 3½-inch measurement, and 47 percent were successful with the 18-inch measurement. The standard for this assessment was that 50 percent of the students should be able to measure both lengths accurately. In Field Test I, the measurement assessments were three in number. Students were to measure objects and distances superimposed on a grid, given the grid dimensions and scale. Almost 35 percent of the students measured accurately.

2-5 and 2-6.

(Refer to Items 12, 16, and 23, page 31, *Formative Evaluation Report 2*)

USE YOUR RULER TO MEASURE THE LENGTH OF THE SHORT AND LONG STRIPS OF PAPER. WRITE YOUR ANSWERS BY THE PICTURE OF THE RULER ON THE LINES BELOW.

SHORT STRIP LONG STRIP



As can be seen from the data, Field Test II student performance for this subtest significantly exceeded both staff-established standards and the student performance in Field Test I on identical or similar items. There was some revision and rearrangement of the activities that are represented in this subtest, but generally it was felt that the materials were successful and should be retained in the commercial edition.

Unit 1, Subtest 3, "Grouping and Classifying"

Table 3 contains a statistical summary of six assessments used as Subtest 3, "Grouping and Classifying." These assessments were administered as Activities 1-15, 1-17, and 1-22 on Worksheets 1-9 and 1-10 in Core B, Unit 1, "Exploring My Environment," second experimental edition, 1972-73.

TABLE 3

Summary Information for Subtest 3
"Grouping and Classifying"
(six items)

This group of items assessed ability to
- differentiate between plants and animals (Item 1)
- follow directions (Item 2)
- complete a task (Item 3)
- differentiate between nonliving things, plants, and animals (Item 4)
- differentiate (list, categorize) characteristics of living things (Item 5)
- determine by what criteria two groups of objects were categorized (Item 6)

Subtest Weighted Scores:
Weights Per Option:

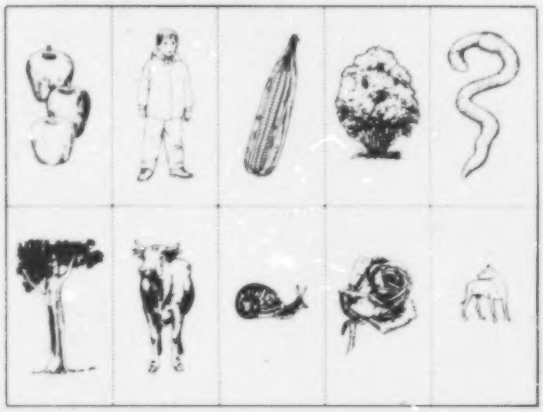
Item	A	B	C	D	E	F	G
1	5	0	-	-	-	0	0
2	5	0	-	-	-	0	0
3	5	0	-	-	-	0	0
4	5	0	-	-	-	0	0
5	3	0	5	0	0	0	0
6	5	0	0	0	0	0	0

Subtest Statistics:
Maximum Possible Score: **30**
Range of Scores: **0-30**
Number of Students: **144**
Mean: **16**

Table 3 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was thirty points, five points for each of six assessments; a possible three points of partial credit could be earned for assessment 5.

Assessment 1 measures student ability to sort and group ten pictures into two categories, plant and animal. Almost 91 percent of the students were successful, compared to the staff standard of 80 percent. No item in Field Test I could be used appropriately for comparison.

3-1.



Assessments 2, 3, and 4 are related to a class pond project. Students made a list of everything contained in the pond, then sorted the items on their lists into three categories: never lived, plants, and animals. Evaluations of the students were made in three areas: following directions, completion of the task, and accuracy in sorting the pond items. Over 95 percent of the students followed directions successfully, 94 percent completed the task, and 54 percent sorted the items correctly. Staff standards for this activity were that 66 percent of the students should perform all three tasks successfully. There were no appropriate items in Field Test I for comparison.

Assessment 5 measures student ability to recall and understand characteristics of living things. Mercury in dilute nitric acid solution sprinkled with potassium dichromate crystals provides an illusion of living characteristics—mobility, reproduction, and color change. Several days after the students watched this demonstration, they were asked which of four statements best described what happened to the mercury in the dish. Successful responses were recorded for 52 percent of the students. Another 7 percent responded to a less accurate but still acceptable choice. The staff had determined that a successful response by 70 percent of the students was an acceptable standard. There was no appropriate assessment item in Field Test I for comparison.

3-5.

YOU SAW SOMETHING MOVING IN A PETRI DISH THAT WE PROJECTED ON A SCREEN. THE THING THAT MOVED WAS MERCURY. WHICH SENTENCE BEST DESCRIBES THE MERCURY? MARK AN X ON YOUR CHOICE.

A. IT WAS DEAD.	7%
B. IT WAS ALIVE.	22%
C. IT NEVER LIVED.	52%
D. IT WAS EATING.	15%

Multiple Response = 2%
No Response = 2%

Assessment 6 measures student ability to determine by what criteria two groups of objects had been categorized and separated. Over 68 percent of the students were successful in determining that the criteria were "living" and "nonliving." The standard for this assessment was that 80 percent of the students should be successful. A similar assessment was also used in Field Test I, where 52 percent of the students responded successfully.

3-6.

(Refer to Item 24, page 35, *Formative Evaluation Report 2*)

LOOK AT THE TWO GROUPS OF OBJECTS.

GROUP I

GROUP II

WHICH WORD PAIR BEST TELLS HOW THE OBJECTS WERE PUT INTO THESE TWO GROUPS?

68%	A. LIVING-NONLIVING	C. HARD-SOFT	10%
10%	B. MOVE-DON'T MOVE	D. WET-DRY	4%

MARK AN X ON YOUR CHOICE.

Multiple Response = 4% **No Response = 4%**

The data on this subtest indicates that it was more difficult for students to determine what categories objects had already been placed in than to place objects in previously defined categories. To improve student understanding of grouping and classifying, activities that related to these concepts were expanded, revised, and rearranged from Core B in the second experimental edition to Core A in the commercial edition. Since so few classes became involved in the pond project (Activity 1-17 in the second experimental edition), it was dropped and replaced by other grouping and classifying activities (see page 26 in *Formative Evaluation Report 3* for details).

Unit 1, Subtest 4, "Spatial Orientation"

Table 4 contains a statistical summary of four assessments used as Subtest 4, "Spatial Orientation." These assessments were administered as Activity 1-29 on Worksheets 1-12 and 1-13 in Core C, Unit 1, "Exploring My Environment," second experimental edition, 1972-73. Table 4 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was eighteen points—five points each for assessments 1, 2, and 3, and three points for assessment 4, with partial credit given for assessment 1.

TABLE 4

Summary Information for Subtest 4
"Spatial Orientation"
(four items)

This group of items measured ability to

- determine compass directions and orientation in relation to directions on a map (Item 1)
- locate the intersection of two streets on a map (Item 2)
- determine compass directions on a map (Item 3)
- locate compass direction from the sun's position (Item 4)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D
1	1	3	5	0
2	0	5	0	0
3	5	0	0	0
4	0	3	0	0

Subtest Statistics:

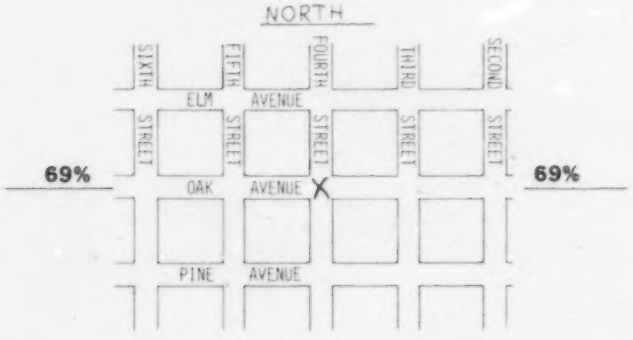
Maximum Possible Score: **18**
Range of Scores: **0-18**
Number of Students: **115**
Mean: **13**

Assessment 1 measures student ability to determine map directions after "north" was given. Approximately 66 percent of the students responded successfully to all parts (three) of the question, 1 percent responded successfully to two parts, 3 percent located "west" only, 22 percent located "south" only, 3 percent located "east" only, and 4 percent did not respond. The standard for this item was that 80 percent of the students should respond successfully to all three directions. Student performance was below this standard. A similar question was used as a posttest item for Field Test I, with 53 percent of the students responding successfully to all items.

4-1.

(Refer to Item 4, page 29 and Items 6 and 25, page 30, *Formative Evaluation Report 2*)

THE MAP BELOW SHOWS PART OF A CITY. NORTH IS MARKED ON A LINE AT THE TOP OF THE MAP. WRITE EAST, WEST, SOUTH IN THE CORRECT PLACES ON THE OTHER THREE LINES.



69% 69%

88%

4-2.

MANUEL LIVES WHERE FOURTH STREET AND OAK AVENUE CROSS. ON THE MAP ABOVE, MARK AN X WHERE OAK AVENUE CROSSES FOURTH STREET.

70% Correctly
30% Incorrectly

4-3.

MARK AN X ON THE LEFT SIDE OF THE MAP.

Assessment 2 measures student ability to mark a particular intersection on a map. The results indicated that 70 percent of the students were able to respond successfully. This compares favorably with the established standard of 44 percent. Only 7 percent of the students responded successfully to this item on Field Test I.

Assessment 3 measures student ability to mark the left side of a map. More than 87 percent of the students were successful, compared to a slightly higher standard of acceptability, 90 percent. There was no comparable question administered on Field Test I.

Assessment 4 tests student ability to view a picture of a boy taken in the late afternoon and to determine which compass direction the boy is facing. Compared to an established standard of 40 percent 65 percent of the students responded successfully. Student performance exceeded acceptable standards. A similar but not identical assessment was used in Field Test I with the result that 34 percent of the students were successful.

4-4.

LOOK AT THE PICTURE BELOW OF A PARK IN LATE AFTERNOON. WHAT DIRECTION IS THE BOY LOOKING?

22%	65%	6%	3%
A. EAST	B. WEST	C. SOUTH	D. NORTH

MARK AN X ON YOUR CHOICE. **Multiple Response = 2%**

No Response = 2%

The data on this subtest indicates that student performance for Field Test II was improved over that of Field Test I. Because some scores were below the acceptable standards, however, and because some teacher feedback recommended certain changes, revision took place on those activities that related to spatial orientation. Refer to page 26 of *Formative Evaluation Report 3* for information on specific activity revision.

Unit 1, Subtest 5, "Specific Information"

Table 5 contains a statistical summary of two assessments used as Subtest 5, "Specific Information." These assessments were administered as Activity 1-29 on Worksheet 1-13 in Core C, Unit 1, "Exploring My Environment," second experimental edition, 1972-73. Table 5 includes item assessment objec-

tives, item scoring, and other subtest statistics. The maximum score for this subtest was ten points, five for each assessment with partial credit given for assessment 2.

TABLE 5

Summary Information for Subtest 5
"Specific Information"
(two items)

This group of items assessed:
- recognition of essentials for life (Item 1)
- ability to define "recycling"

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G	H	I	J	K	L
1	1	0	0	1	0	1	0	0	0	1	1	0
2	0	0	5	0	0	0	-	-	-	-	-	-

Subtest Statistics:

Maximum Possible Score: **10**
Range of Scores: **2-10**
Number of Students: **144**
Mean: **6**

Assessment 1 measures the students' ability to select from a list of twelve items the ones they could not live without. Nearly 22 percent of the students selected all five of the most logical choices, 45 percent selected four of five, and 23 percent selected three of five. Therefore, just under 90 percent selected at least three of the most logical choices compared to the staff-established standard of 80 percent. A similar assessment was used for Field Test I, the only difference being that students were asked to select the choices they could live without. Thirty-nine percent of the students responded successfully to this item in Field Test I. This difference could be accounted for by material revisions that took place between the two experimental editions. It also could be attributed to a rewording in the assessment itself. Generally this population of field-test students had a more difficult time answering a question expressed as a negative rather than a positive.

5-1.

(Refer to Item 27, page 36, *Formative Evaluation Report 2*)

MARK AN X ON EACH THING WHICH YOU COULD NOT LIVE WITHOUT.

A. AIR	B. GASOLINE	C. CEMENT	D. FOOD
E. AIRPLANES	F. WATER	G. TV	H. SOIL
I. CARS	J. FRIENDS	K. SHELTER	L. HIGHWAYS

5% One Response
3% Two Responses
23% Three Responses (air, food, water)
2% Three Responses (other combinations)
45% Four of Five Responses
22% All Five Responses (air, food, water, friends, shelter)

Assessment 2 measures student understanding of a definition of recycling. Although 70 percent of the students responded successfully, that was somewhat under the staff-established standard of 75 percent. This assessment item had no counterpart in Field Test I that could be used for comparison.

Both assessment items in Subtest 5 evaluate student knowledge about concepts introduced in Unit 1 but developed more fully in later units. Ninety percent of the students selected at least three environmental components essential for life, and 70 percent of them knew a functional definition for recycling. That indicates a good baseline of understanding for building the next units.

Unit 1, Subtest 6, "Picture Taking"

The one item of assessment in Subtest 6 is by no means a test, and could be classed more appropriately as a skill-development activity. A Polaroid camera was selected as an optional piece of equipment for the ME AND MY ENVIRONMENT curriculum. The main reasons for its selection can be summarized in three points: it provides instant feedback to students; it provides another avenue for development of manipulative skills; and it aids in documenting portions of an experiment. To evaluate student success with this curricular aid, the activity labeled "Subtest 6" was developed. Students first familiarized themselves with the camera, then practiced different poses against selected backgrounds.

Students were evaluated on the quality of their pictures in terms of focus, exposure, positioning, and steadiness. Fifty-two percent of the students were successful in using the camera, and another 32 percent had only minor problems. Examples of the students' work appear in *BSCS Newsletter 55*, page 26. The standard for this assessment was for 66 percent of the students to take good pictures or have only minor problems. Student performance far exceeded this with an 84 percent performance. As a point of contrast, only 25 percent of the teachers and staff took pictures of good quality after instruction by a Polaroid sales representative.

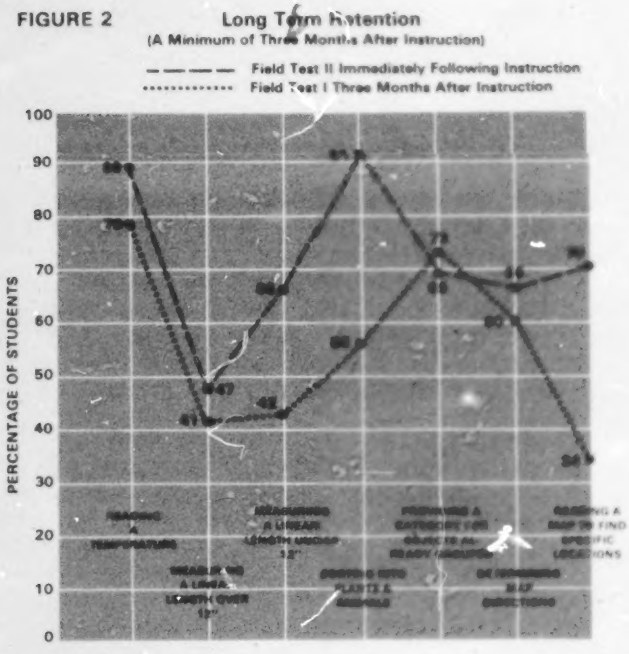
Long-term Retention

As discussed in the section on "Clues to Success," a major difference between Field Tests I and II was the manner in which student performance data was collected. For Field Test I, data was collected on identical pre- and posttests, administered preceding and following each unit of instruction. For Field Test II, data was collected from "Clues to Success" activities incorporated in each unit and administered at various intervals during instruction.

Because of the Field Test II data collection format, there was no opportunity for evaluation of the students' long-term retention of subject matter covered in the curricular materials. Therefore, for this reason and because BSCS staff needed student baseline data before commencing instruction of Unit 3, "Energy Relationships in My Environment," (revised Unit 2, part 1, 1971-72 first experimental edition) in the fall of 1973, at least three months after instruction, a number of assessment items were administered to students who had completed Unit 1.

The above data are from the two separate groups of students; no attempt was made to obtain a random sample. In addition, though the questions administered were identical in both field-test groups, instruction did vary within and between groups. Thus, no generalizable conclusion can be drawn as to the retentive ability of these students. Since the seven areas of retention illustrated here reflect objectives where mastery was called for, it did help the developers in making decisions

FIGURE 2



about further revision. (See Figure 2 for a summary of the comparisons.)

Five items assessed student retention of the ability to measure accurately temperature and length. Students were assessed on their ability to read three different temperatures within ± 2°F. Nearly 46 percent of the students were successful on all three readings and 79 percent were successful on two out of three readings. This compares favorably with an 89 percent student success performance on identical questions used in Field Test II that were administered immediately following instruction.

Students were also assessed on their ability to measure two different lengths within ¼ of an inch; one was over 12 inches and the other was under 12 inches. Nearly 41 percent of the students were successful with the over-12-inch length, and 42 percent were successful with the under-12-inch length. During Field Test II, 47 percent of the students were successful with the over-12-inch measurement, and 66 percent were successful with the under-12-inch measurement. For this population of students, those who first developed the ability to measure accurately over 12 inches were able to retain their measurement ability longer than those who initially developed the ability to measure only under 12 inches.

Two items assessed student retention of the ability to group and classify objects into categories. One item measured student ability to sort and group ten pictures into two categories—plants and animals. Nearly 50 percent of the students were successful with this compared to a 91 percent performance on an identical question used in Field Test II. This marked drop in retention further justified the expansion of grouping activities in Unit 1 of the commercial edition. Another item measured ability of students to provide a category for a group of objects shown on a slide. Slightly over 73 percent of the students were successful compared to a 69 percent performance on a similar question used in Field Test II which was administered immediately following instruction. It is interesting to note that although students had more difficulty in determining a category for a group of objects in comparison to placing objects in defined categories, they retained more of the former than of the latter.

Five items assessed student retention of ability in locating compass directions and other spatial orientation. Two assessments measured student ability to determine map directions. Over 60 percent of the students retained this ability compared to an initial student success of 66 percent on identical questions. Three more items measured student ability to read a map and find specific locations. Only 34 percent of the students were successful on these assessments, while 70 percent of the students were successful on these items immediately after instruction. This performance further substantiated the need for expansion and revision of those activities related to spatial orientation. ■

student performance on items assessing instruction in unit 3, "energy relationships in my environment," field test II

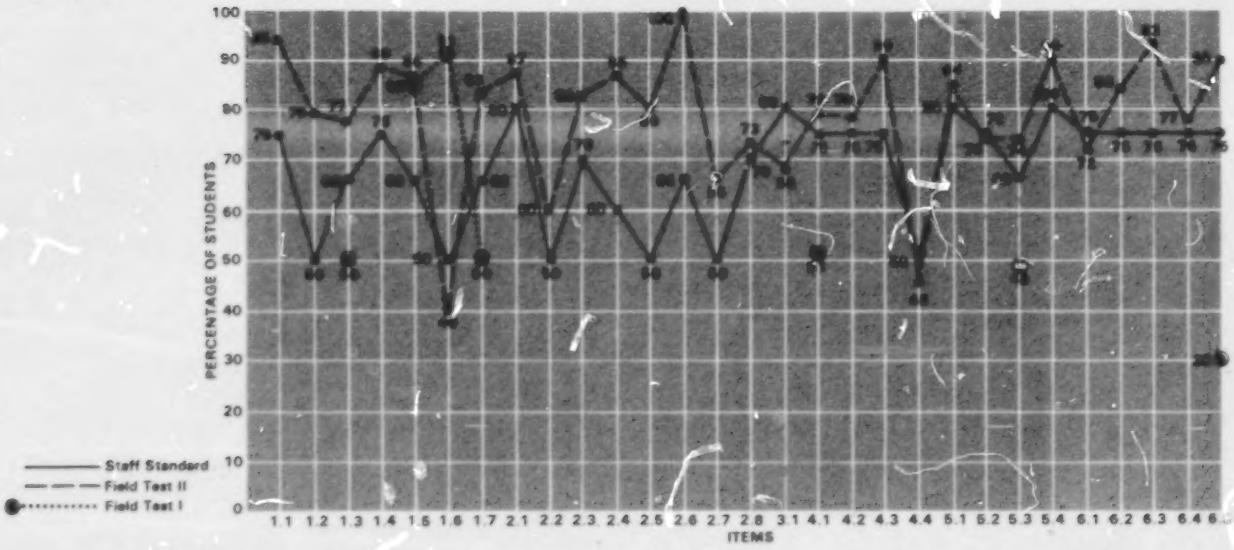
Twenty-nine of the sixty-two items used in Field Test II directly relate to materials and instruction in Unit 3, "Energy Relationships in My Environment." Unit 3 materials originally appeared in Unit 2, part 1 of the 1971-72 first experimental edition. These now appear in Unit 3 of the commercial version in revised form. The twenty-nine items assessed materials and instruction presented in the twenty-five activities of the unit. The items fell into six categories by topic: 1) Relationship of Temperature, Energy, and Work; 2) Graphing and Reading a Graph; 3) Full and Healthy Game; 4) Food Energy and Diet; 5) Food Chains and Webs; and 6) Plants and Their Source of Food and Energy. As in the analysis of Unit 1 items, it was considered most appropriate to examine each item in the Unit 3 subtests individually.

Results are presented with a brief discussion of each item, the percentage of students responding successfully, comparisons to staff-established standards, and, when possible, to similar or identical items used in Field Test I, a brief analysis, and explanation of revisions, expansion and/or deletions that took place in the commercial version as a result of student performance on these assessments.

In the case of the second experimental edition of Unit 3 (Field Test II) the students achieved at or above standard in twenty-six of the twenty-nine instances. Of the seven similar but not necessarily identical items in the first experimental edition of Unit 3 (Field Test I) only one was higher than the results of Field Test II. As in the case of Unit 1 this reflects an improvement in the materials as well as in the items used in the two field tests.

Figure 3 shows a summary of results from the use of the test items.

FIGURE 3 A Comparison of Staff Standards of Achievement in Unit 3 with Actual Results in Field Tests I and II



Unit 3, Subtest 1, "Relationship of Temperature, Energy, and Work"

Table 6 contains a statistical summary of seven assessment items used as Subtest 1, "Relationship of Temperature, Energy, and Work." These assessments were administered as Activites 3-4 and 3-5 on Worksheets 3-3 and 3-4 in Core A, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73. Table 6 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was thirty-five points, five points each for seven assessments.

Assessment 1 measures student ability to predict which of two beakers containing tea bags—one with hot water and one with cold—will provide tea first. Compared to the staff standard of acceptability of 75 percent, 94 percent of the students responded successfully. There was no Field Test I assessment appropriate for comparison.

Assessment 2 measures students' ability to defend their answers in assessment 1. Results reveal that 56 percent responded successfully, 23 percent responded with a weak defense, and 21 percent did not respond. The staff had established a 50 percent student performance standard of acceptability. There was no Field Test I assessment appropriate for comparison.

TABLE 6

Summary Information for Subtest 1
"Temperature, Energy and Work"
(seven items)

This group of items assessed:
- understanding that energy is the ability to do work (Items 5, 6, 7, and 11)
- awareness that the higher the temperature, the higher the energy (Items 1, 2, 5, and 6)
- awareness that work and temperature are directly related (Items 3, 4, and 7)

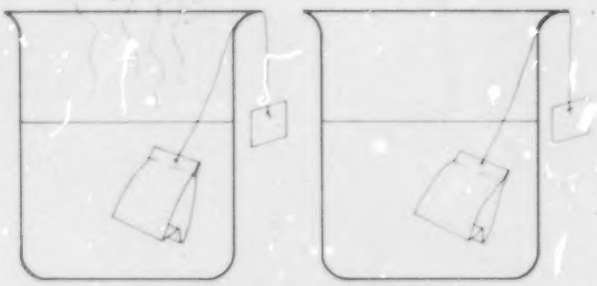
Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D
1	5	0	-	-
2	5	0	-	-
3	0	5	-	-
4	0	0	0	5
5	0	0	0	5
6	5	0	0	0
7	0	5	0	0

Subtest Statistics:

Maximum Possible Score: **35**
Range of Scores: **0-35**
Number of Students: **157**
Mean: **16**

1-1.



Which will be ready first ? _____

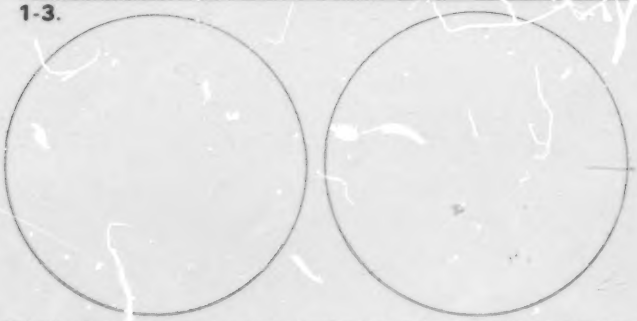
1-2.

Why ? _____

Explanation of prediction:	**good 56%**
	weak 23%
	none 21%

Assessment 3 measures student ability to predict which of two petri dishes contains the warmest water after watching the diffusion of a potassium permanganate crystal in both dishes. Data shows that 77 percent of the students responded successfully; 14 percent were unsuccessful; and 9 percent did not respond. The staff standard of acceptability was 66 percent. About half of the students were successful on a comparable assessment in Field Test I.

1-3.



Prediction of temperature (selection of petri dish with the warmest water in it).

77% Correct
14% Incorrect
9% No Response

Assessment 4 measures student ability to predict which of four test tubes containing water and capped by a stopper will pop its stopper first under four different heating conditions. Compared to a 75 percent staff standard, 88 percent of the students responded successfully. There was no comparable assessment on Field Test I for analysis.

Assessment 5 measures student ability to determine which tube of water has the most energy. Compared to a 66 percent standard of acceptability, 86 percent of the students responded successfully. On quite a different assessment, but related to the same objective in Field Test I, 85 percent of the students responded successfully. (See Items 18 and 19, page 37, *Formative Evaluation Report 2.*)

Assessment 6 measures student ability to determine which test tube is able to do the least amount of work. Compared to a student performance standard of 50 percent, only 40 percent of the students were successful. Student performance was significantly below acceptable standards. The somewhat comparable assessment on the posttest for Field Test I in which the most amount of work was asked for had 91 percent of the students responding successfully.

Assessment 7 measures student ability to predict the fastest rate of diffusion between chemicals in four different beakers at four different temperatures. Results show that 83 percent of the students were successful compared to a 66 percent staff standard of acceptability. A comparison with Item 21, page 39, of *Formative Evaluation Report 2* shows 50 percent of the students were successful in grasping the concept as measured by that item.

LOOK AT THE DIAGRAMS BELOW

1-4.

WHICH OF THE TEST TUBES OF WATER WILL POP THE CORK THE FASTEST?

A	B	C	D
1%	3%	7%	88%

No Response = 1%

MARK AN X ON YOUR CHOICE.

1-5.

WHICH TEST TUBE OF WATER IS RECEIVING THE MOST ENERGY?

A	B	C	D
8%	1%	5%	86%

MARK AN X ON YOUR CHOICE.

1-6.

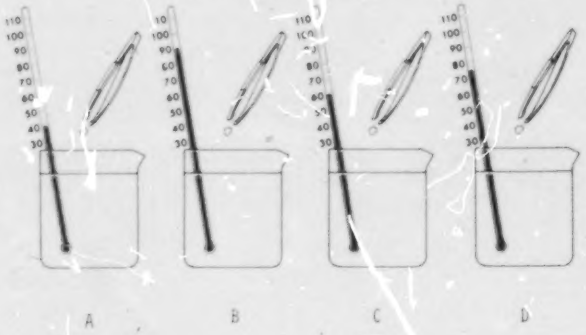
WHICH TEST TUBE OF WATER IS ABLE TO DO THE LEAST AMOUNT OF WORK?

A	B	C	D
40%	32%	12%	16%

MARK AN X ON YOUR CHOICE.

1-7.

EACH BEAKER HAS THE SAME AMOUNT OF WATER. A THERMOMETER SHOWS THE TEMPERATURE OF THE WATER IN EACH BEAKER. A CRYSTAL OF PURPLE CHEMICAL IS DROPPED INTO EACH BEAKER.



IN WHICH BEAKER WILL THE PURPLE CHEMICAL SPREAD THE FASTEST?

A	B	C	D
7%	83%	5%	5%

MARK AN X ON YOUR CHOICE.

Student performance on this subtest was exceptional and in fact surprising to the staff. Some curriculum developers felt that the relationships between temperature, energy, and work were too abstract for this population of students and that correspondingly, performance would be low. Although there was revision and rearrangement, these concepts and their associations were deemed appropriate for EMH students and were included in the commercial edition.

An interesting trend is beginning to emerge. Note that on assessment 6 student performance was low. This is representative of many examples in this curriculum where students had difficulty with understandings that were *opposite* to those emphasized in the activities. For example, students learn that a high temperature provides high energy, but they have great difficulty extending this concept to comprehend that a low temperature provides low energy. It should be pointed out to EMH curriculum developers that both types of activities must be developed before student understanding is maximized.

Unit 3, Subtest 2, "Graphing and Reading a Graph"

Table 7 contains a statistical summary of eight assessment items used as Subtest 2, "Graphing and Reading a Graph." These assessments were administered as Activities 3-7, 3-8, and 3-10 on Worksheets 3-7, 3-8, and 3-9 in Cores A and B, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73. Table 7 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was forty points, five points each for eight assessments.

TABLE 7

Summary Information for Subtest 2
"Graphing and Reading a Graph"
(eight items)

This group of items assessed the ability to

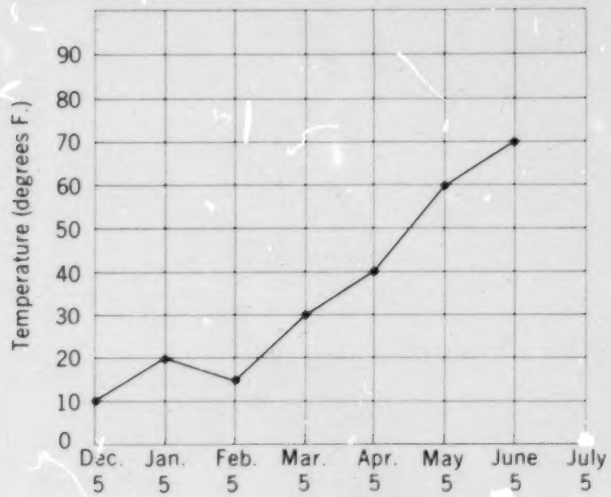
- recognize correct graphing and interpret the graph (Items 1, 2, and 3)
- enter data on a graph (Item 4)
- label graph axis and enter data (Item 5)
- label graph axis, enter data, and graph results (Items 6, 7, and 8)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F
1	0	5	-	-	-	-
2	0	5	-	-	-	-
3	0	0	5	0	0	0
4	5	0	0	0	0	0
5	0	5	-	-	-	-
6	0	5	-	-	-	-
7	5	0	-	-	-	-
8	0	5	-	-	-	-

Subtest Statistics:

Maximum Possible Score: **40**
Range of Scores: **0-40**
Number of Students: **142**
Mean: **21.5**



2-1.

WHAT WAS THE TEMPERATURE ON JANUARY 5 ? _____

2-2.

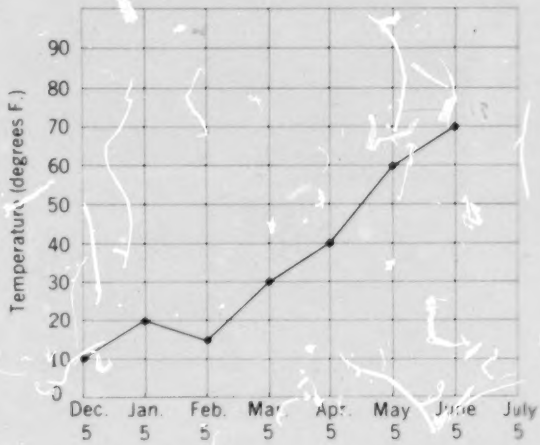
WHAT WAS THE TEMPERATURE ON FEBRUARY 5 ? _____

Assessment 1 shows a graph of dates and temperatures, and asks students to identify a particular temperature on a particular day. Nearly 88 percent of the students responded successfully compared to an 80 percent standard of acceptability.

Assessment 2 asks students a question similar to assessment 1, except that to read the temperature accurately, the students must interpolate. Compared to a 50 percent standard of acceptability, 60 percent of the students were successful. There was no comparable question on the Field Test I posttest.

Assessment 3 measures student ability to perceive a trend or pattern in a graph over a period of time. Almost 83 percent of the students were successful compared to an acceptable student performance standard of 70 percent. There was no comparable question on the posttest for Field Test I.

Assessment 4 measures student ability to enter a new temperature on the graph. Compared to a 60 percent staff standard, 86 percent of the students were successful. There was no question for comparison on Field Test I.



2-3.

COMPARE THE TEMPERATURES FROM JANUARY 5 TO JUNE 5. WHICH SENTENCE BELOW BEST TELLS WHAT HAPPENED TO THE TEMPERATURE?

IT WENT UP.	IT WENT DOWN.	IT STAYED THE SAME.
83%	**8%**	**7%**

MARK AN X ON YOUR CHOICE.

Write in of "They were different." = 2%

2-4.

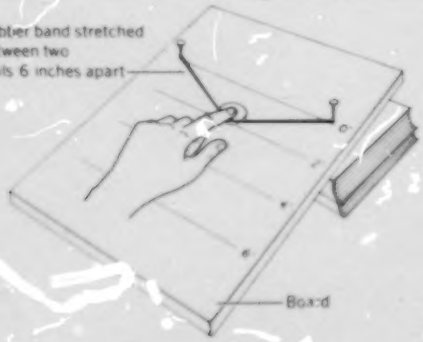
THE TEMPERATURE ON JULY 5 WAS 90°. PLACE A DOT ON THE GRAPH TO SHOW THAT TEMPERATURE.

86% = Correct 8% = Incorrect Date

4% = Incorrect Temperature 2% = Both Incorrect

Assessment 5 provides the students with graph axes labels and asks them to record their data from the High Flyer game. In this game, students worked with the relationship between energy input and energy output when launching a checker or bottlecap with a rubber band. Results revealed that 80 percent of the students completed this task successfully compared to a 50 percent staff standard. Once again, no comparable question was used in the Field Test I posttest.

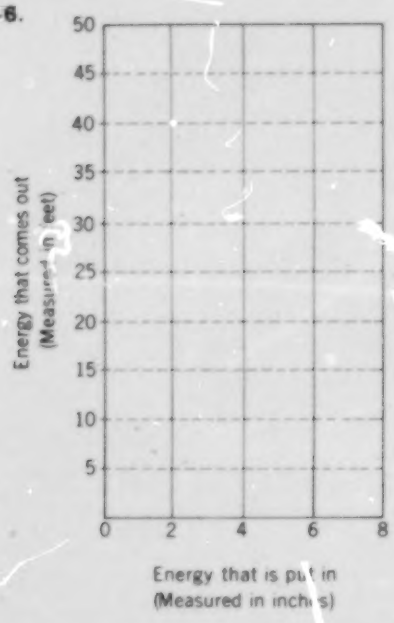
2-5.



	INCHES RUBBER BAND MOVED	2"	4"	6"
FLYER 1 name	FEET CAP TRAVELED			
FLYER 2 name	FEET CAP TRAVELED			
FLYER 3 name	FEET CAP TRAVELED			

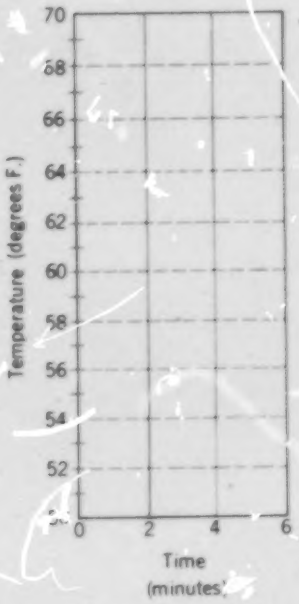
Assessment 6 measures student ability to graph the data entered from assessment 5 as it appeared on Worksheet 3-9. All of the students (100 percent) were successful compared to a 66 percent standard of acceptability for student performance. There was no comparable question on the Field Test I posttest. In this case, it would appear that the results are not completely reliable, since worksheets are often completed as a group activity, though such was not to be the case in this instance.

2-6.



Assessment 7 measures student ability to record and graph data on temperature vs. time. The data was collected from thermometer readings of water in a beaker under an extreme condition of agitation. Without teacher assistance, 66 percent of the students recorded and graphed this data successfully. Problems with recording temperature hampered 20 percent of the students and 13 percent had problems with time. The staff standard for this assessment was 50 percent. This question had no counterpart on the Field Test I posttest.

2-7.



Assessment 8 is identical to assessment 7 except that two additional conditions of water agitation were introduced—mild and no agitation. Under these two additional conditions, 73 percent of the students successfully recorded and graphed data. Because of the similarity to assessment 7, the staff felt that 70 percent of the students should have performed successfully. This standard was met. This assessment had no counterpart on the Field Test I posttest.

Again, the student performance on this subtest pleasantly surprised the curriculum developers. The abilities required to perform successfully on the subtest included interpretation, recording, graphing, labeling, and drawing; many of these skills before that time had been considered beyond the abilities of EMH students.

One of the real rewards students achieve from success in graphing and recording is that by these means they can communicate data, information, and understandings accurately; there is no need for a great deal of oral or written communication, where many EMH students are weak.

Some revision and slight rearrangement took place in the commercial edition of Unit 3, but generally, the concepts introduced in the 1972-73 second experimental edition were retained.

Date _____ Name _____

SCORESHEET
FULL AND HEALTHY GAME

	MEAT	DAIRY	FRUIT & VEGETABLES	BREADS & CEREALS
MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
FRIDAY				
SATURDAY				
SUNDAY				

MONDAY				
TUESDAY				
WEDNESDAY				
THURSDAY				
FRIDAY				
SATURDAY				
SUNDAY				

BSCS Worksheet 3-14

Unit 3, Subtest 3, Full and Healthy Game

The only item assessment for Subtest 3 measures student ability and knowledge of health and nutrition as determined by their success in playing a card game related to these concepts. This assessment was administered as Activity 3-13 on Worksheet 3-14 in Core B, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73.

The object of the game, which is similar to rummy, is for the students to draw and discard food cards until they make three meals that include certain proportions of the four food groups. Results reveal that 68 percent of the students grasped the game concepts and successfully met game objectives. The staff had established that 80 percent of the students should play the game successfully. Student performance was below that standard, but more importantly, students lost interest in playing, perhaps because they were bored with another card game based on the rummy format, or perhaps because the writing and computation were too difficult for them. The Full and Healthy game was not used in Field Test I materials; therefore, no comparison can be made.

As a result of student performance and teacher feedback reports, this game was deemed too difficult and therefore has been omitted in the commercial edition. It was replaced by a puzzle game entitled Go and Grow, which stresses the same objectives but relies on a four-color pictorial format. The writing and computational skills called for in the Full and Healthy game are replaced by manipulation skills.

Unit 3, Subtest 4, "Concepts of Food, Energy, and Diet"

Table 8 contains a statistical summary of four assessment items used as Subtest 4, "Food, Energy, and Diet." These assessments were administered as Activity 3-14 on Worksheet 3-16 in Core B, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73. Table 8 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was twenty points, five for each of four questions.

TABLE 8

Summary Information for Subtest 4
"Food, Energy and Diet"
(four items)

This group of items assessed knowledge that
- food is the body's source of energy (Item 1)
- calories and energy are directly related (Items 2, 3, and 4)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G
1	5	0	0	0	0	0	0
2	5	0	0	0	0	0	0
3	0	0	5	0	0	0	0
4	0	5	0	0	0	0	0

Subtest Statistics:

Maximum Possible Score: **20**
Range of Scores: **0-20**
Number of Students: **163**
Mean: **12**

In Assessment 1, students are given a short Popeye, Olive Oyl, Brutus vignette and a chart of foods with their associated energy in calories. As always, Popeye must rescue Olive Oyl, but his ever-present spinach is gone and he must turn to a different food choice. Students are asked why he must eat before the rescue. The data shows that 79 percent responded successfully, and 10 percent more were close to correct in their answers. The staff-established standard for student performance acceptability was 75 percent. On the Field Test I posttest, a question assessing the same understandings was responded to successfully by 51 percent of the students.

Assessment 2 asks the students what food Popeye selected for his needed "go power." Compared to a staff standard of 75 percent, 78 percent of the students responded successfully. There was no comparable assessment on Field Test I.

"Help, help." Popeye heard Olive Oyl's distant cries. He looked out the door just in time to see her disappear down the hill under the arm of his arch rival, Brutus.

"I must be quick," thought Popeye, "or Brutus will have vanished with my sweet Olive Oyl and I may never find her again." Popeye turned to his can of spinach. "My supply is gone!!" he groaned. "Help! What shall I do? In just five short minutes she will be gone forever!!" Quick-thinking Popeye looked at his ever-handy calorie book:

CALORIE BOOK

FOOD	CALORIES PER SERVING
Baked beans	135
Bread	64
Milk	90
Oranges	80
Peanuts	174
Sugar	116
Syrup	76
T-bone steak	200
Carrots	20

"Ah, here it is at last -- just what I need!" With the speed of lightning he ran to his cupboard, grabbed the highest energy food, and ate it up. AHA! What energy!! He felt his muscles begin to pop. Suddenly he dashed off, running as fast as a bullet to rescue Olive. Just in the nick of time, he passed over the head of Brutus, swooped up Olive Oyl, and disappeared into the distance with her.

4-1. (Refer to Item 9, page 38, *Formative Evaluation Report 2*)

POPEYE WANTED TO EAT FOOD BEFORE TRYING TO RESCUE OLIVE OYL, BECAUSE HE KNEW FOOD CONTAINS _____

79% = **Energy** **10%** = **Calories**

9% = **Other** **2%** = **No Response**

4-2. WHICH FOOD ON THE CALORIE CHART DID POPEYE CHOOSE FOR THE MOST "GO POWER"? _____

78% = **Steak** **4%** = **Peanuts** **2%** = **Beans**

2% = **Sugar** **13%** = **Other**

Assessment 3 asks why their selection in assessment 2 had the most "go power." Compared to a staff standard of 75 percent, 90 percent of the students responded successfully. There was no comparable question on Field Test I.

4-3. WHY DID YOU SAY THIS FOOD HAS THE MOST "GO POWER"?

6%	A. BECAUSE I LIKE IT.	
2%	B. BECAUSE IT COSTS MORE.	
90%	C. BECAUSE MORE ENERGY IS IN IT.	X
1%	D. BECAUSE THERE IS MORE OF IT.	

MARK AN X ON YOUR CHOICE.

Assessment 4 measures student ability to determine which food on the chart Popeye would have to eat the most of to get the same amount of energy as in their selection of assessment 2. Only 45 percent of the students responded successfully compared to a staff standard of 50 percent. There was no comparable assessment on Field Test I. Again we see student difficulty in handling concepts opposite from those emphasized in the activities.

4-4. WHICH WOULD YOU HAVE TO EAT THE MOST OF TO GET THE SAME AMOUNT OF ENERGY?

12%	A. BAKED BEANS	45%	C. ORANGES X
33%	B. STEAK	6%	D. BREAD

MARK AN X ON YOUR CHOICE.

Generally, student performance on this subtest was acceptable. Some revision took place to eliminate student confusion between energy, "go power," and quick energy. The Popeye story was revised for just that reason. Additional activities were added and others expanded to reinforce further the relationship between food, calories, energy, and work.

Unit 3, Subtest 5, "Food Chains and Webs"

Table 9 contains a statistical summary of four assessment items used as Subtest 5, "Food Chains and Webs." These assessments were administered as Activity 3-19 in Core C, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73. Table 9 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was twenty-one points, five points each for assessments 1, 3, and 5, and six points for assessment 2.

TABLE 9

Summary Information for Subtest 5
"Food Chains and Webs"
(four items)

This group of items assessed ability to

- determine the interdependence between plants and animals in a food web (Items 1, 2)
- identify the appropriate links in a food chain (Item 3)
- develop a food web (Item 4)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G
1	0	5	0	0	0	0	0
2	0	1	1	1	1	1	1
3	0	5	0	0	0	0	0
4	0	3	4	5	0	0	0

Subtest Statistics:

Maximum Possible Score: **21**
Range of Scores: **0-21**
Number of Students: **147**
Mean: **11**

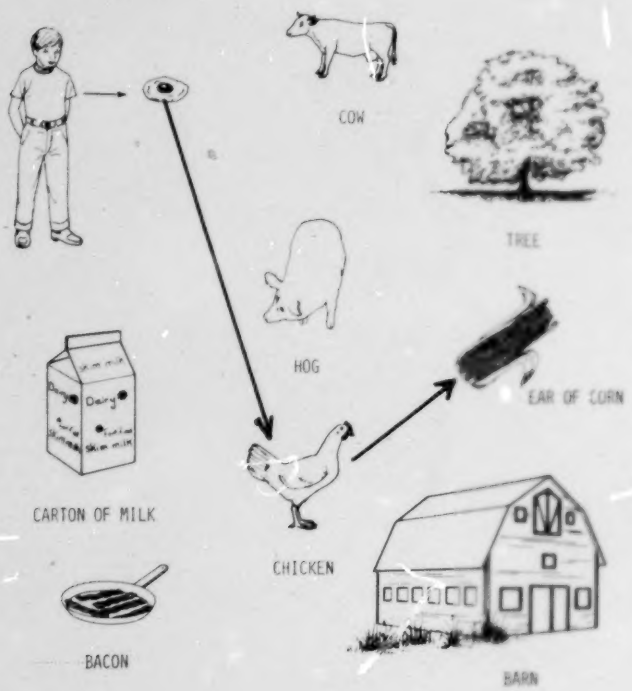
Assessment 1 measures student knowledge of the interdependence of animals and plants in a food web. Students using flashcards connected with string were asked the results of removing a particular plant or animal from a food web. Compared to a staff standard of 80 percent, 84 percent of the students responded successfully. There was no comparable question on the Field Test I posttest.

Assessment 2 measures student knowledge of what might happen to the food web now that something has been removed. The fact that some animals would starve and die was indicated by 26 percent of the students; 25 percent did not respond to the question; 6 percent indicated organisms would decrease; 8 percent indicated organisms would increase; 9 percent said that the animals would move someplace else; and 25 percent answered two or more of the above. The staff had established a student performance acceptability standard of 75 percent with at least one correct response. This standard was met. There was no assessment for comparison in Field Test I.

Assessment 3 asks students to connect pictures in a food chain, starting with a boy who is eating an egg for breakfast. Results show that 74 percent of the students completed this task successfully, compared to a 60 percent staff standard. This same question on the Field Test I posttest revealed that 49 percent of the students responded successfully. In the commercial revision the further distinction is made between a food source chain and a typical food or energy chain.

5-3. (Refer to Item 6, page 39, *Formative Evaluation Report 2*)

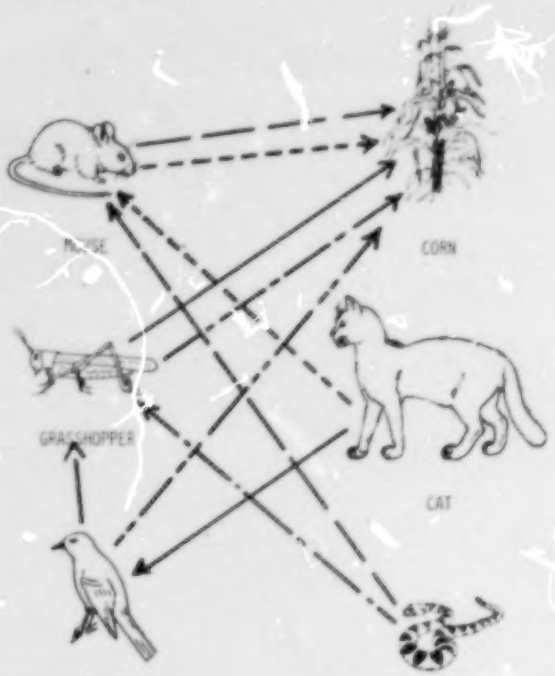
A BOY ATE AN EGG FOR BREAKFAST. DRAW ARROWS BETWEEN THE PICTURES PICTURES BELOW TO SHOW THE REST OF THE FOOD CHAIN.



Assessment 4 provides a worksheet with six animal and plant pictures and asks students to develop a food web. Five associations were made by 44 percent of the students, 46 percent made three or four associations, 5 percent made two or fewer, and 5 percent made more than five associations. The staff had established that 80 percent of the students should make three or more associations. This standard was met by 90 percent of the students. There was no comparable question in Field Test I.

5-4.

MAKE A FOOD WEB BY DRAWING ARROWS TO POINT TO WHERE EACH THING GETS ITS FOOD ENERGY.



There was some revision and rearrangement of activities related to this subtest, but generally they were considered appropriate and successful with EMH students.

TABLE 10

Summary Information for Subtest 6
"Plants and Their Source of Food"
(five items)

This group of items assessed knowledge
- that plants make their own food (items 1, 2, 3, and 4)
- about the need for an animal dependence upon plants (item 5)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G	H	I	J
1	0	5	0	0	0	0	0	0	0	0
2	0	5	0	0	0	0	0	0	0	0
3	0	5	0	0	0	0	0	0	0	0
4	0	5	0	0	0	0	0	0	0	0
5	0	0	1	0	1	1	0	1	1	1

Subtest Statistics:
Maximum Possible Score: 26
Range of Scores: 0-26
Number of Students: 163
Mean: 14

Unit 3, Subtest 6, "Plants and Their Source of Food and Energy"

Table 10 contains a statistical summary of five assessment items administered verbally without pencil or paper and used as Subtest 6, "Plants and Their Source of Food and Energy." These assessments were administeactivities 3-24 and 3-2re D, Unit 3, "Energy Relationships in My Environment," second experimental edition 1972-73. Table 10 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was twenty-six points, five points for assessments 1, 2, 3, and 4, and six points for assessment 5.

Assessment 1 measured student knowledge of whether or not water is a plant food. Compared to a 75 percent standard, 72 percent of the students responded successfully. There was no comparable question in the Field Test I posttest for analysis.

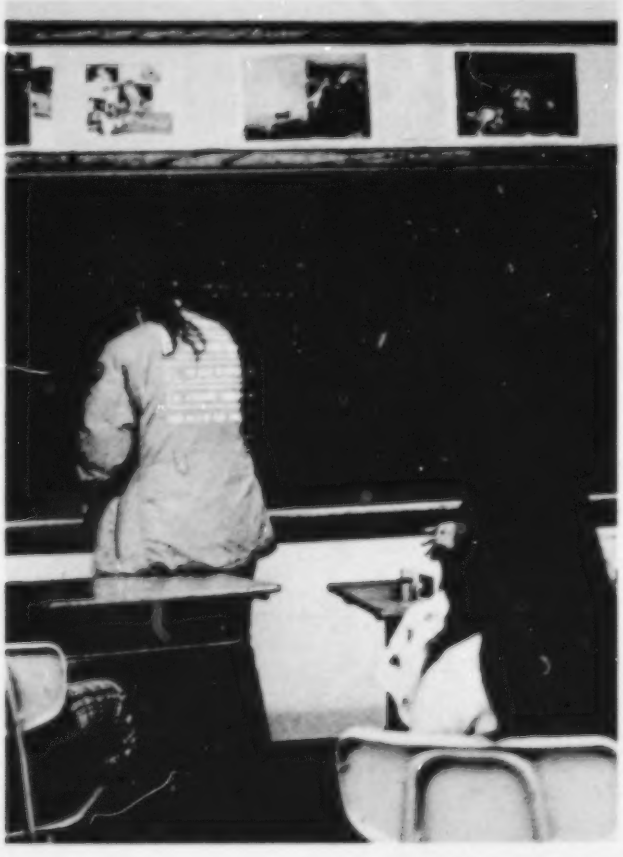
Assessment 2 measured student knowledge of whether or not light is a plant food. Compared to a 75 percent standard, 83 percent of the students responded correctly. There was no comparable question in the Field Test I posttest for analysis.

Assessment 3 measured student knowledge of whether or not air is a plant food. Results show that 93 percent of the students responded correctly compared to a 75 percent standard. There was no question for comparison on the Field Test I posttest.

Assessment 4 measured student knowledge of whether or not soil is a plant food. The data reveal that 76 percent of the students responded correctly, compared to a 75 percent standard. There was no question for comparison on the Field Test I posttest.

Assessment 5 from Activity 3-25 measured student ability to check the correct statements about plants from a list of ten. All six correct responses were selected by 41 percent of the students; 31 percent selected five correct responses; 18 percent selected four, 5 percent selected three, and 5 percent selected only one or more. In summary, 90 percent of the students selected four or more correct statements compared to a 75 percent standard. There was no single assessment on the Field Test I posttest that was comparable; however, three assessments included identical statements used in Activity 3-25. The three assessments had an average correct student percentage response of 30 percent.

Student performance and teacher feedback on the activities related to this subtest were acceptable. However, because Unit 3 was too long to be completed in one semester and because the activities represented in Subtest 6 were tangential to the main themes of the unit, they were omitted in the commercial edition. They may be included in future units. ■



student performance on items assessing instruction in unit 2, "me as a habitat," field tests I and II

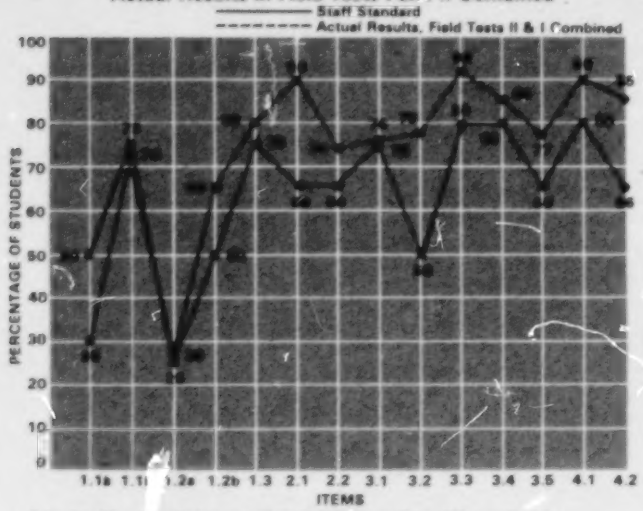
Eleven of the sixty-two items used in Field Test II directly related to materials and instruction in Unit 2, which was revised from Unit 2, part 2, 1971-72 first experimental edition. On the basis of findings from Unit 1, Unit 2 was revised *prior* to Field Test I rather than after, and therefore Field Tests I and II were evaluations of the same materials, using the same subtests. Field Test I preceded Field Test II by about four months. Because of this, data for the two field tests was pooled as one, nearly doubling the population size. For obvious reasons, student performance on the assessments was compared exclusively to staff-developed standards rather than comparisons between the two field tests. The eleven items assessed materials and instruction presented in the nineteen activities of the unit, and the items fell into four categories by topic: 1) Microbe Needs; 2) Pictures and Drawings of Microbes; 3) Microbe Fighters and Venereal Disease; 4) Poster on Drugs. As in the analysis of Unit 1 and 3 items, it was considered most appropriate to examine each item in Unit 2 subtests individually.

Results are presented with a brief discussion of each item, percentage of students responding successfully, comparisons to staff-established standards, a brief analysis, and explanation of revisions, expansions, and/or deletions that took place in the commercial version as a result of student performance on these assessments.

Staff standards set for each of the items assessing the materials and instruction were exceeded in all but one instance. Since there was no revision between the two field tests the actual results are a reflection of the pooling of both groups. A summary of the results follows. (See Figure 4.)

FIGURE 4

A Comparison of Staff Standards of Achievement in Unit 2 with Actual Results in Field Tests I and II Combined



Unit 2, Subtest 1, "Microbe Needs"

Table 11 contains a statistical summary of three assessment items used as Subtest 1, "Microbe Needs." These assessments were administered as Activity 2-8 on Worksheet 2-3 in Core A, Unit 2, experimental editions 1971-72 and 1972-73. The maximum score for this subtest was fifteen points, five points for each assessment with partial credit of three points for each item.

TABLE 11

Summary Information for Subtest 1
"Microbe Needs"
(three items)

This group of items assessed knowledge of the relationship between microbes and

- man as an environment (Items 1 and 3)
- microbe fighters (Items 2 and 3)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G
1	0	3	0	3	5	0	0
2	0	0	3	3	5	0	0
3	0	0	5	0	0	0	0

Maximum Possible Score: **15**
Range of Scores: **0-15**
Number of Students: **292**
Mean: **8.3**

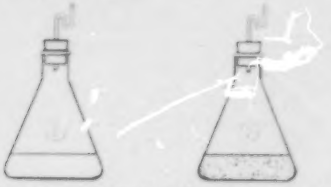
Assessment 1 asks why microbes like you. The data reveals that 30 percent of the students selected both correct responses, 44 percent more selected one of the correct responses. The staff had established the standard that 75 percent of the students should select at least one correct choice and 50 percent should select both. The performance results were slightly below those standards. Because there was no revision between Field Tests I and II, and therefore no difference between the curricular materials, data was pooled rather than compared.

1-1. WHY DO MICROBES LIKE YOU?

7%	A. YOU ARE BIGGER THAN THEY ARE.
54%	X B. YOU GIVE THEM WARMTH TO GROW.
4%	C. YOU HAVE GOOD GROOMING HABITS.
50%	X YOU PROVIDE THEM WITH A SOURCE OF FOOD AND WATER.

MARK AN X ON THE IMPORTANT REASONS.

1-2



BOTH OF THESE BOTTLES HAVE AGAR IN THEM. BOTTLE 1 HAS NO MICROBES GROWING IN IT. BOTTLE 2 HAS MICROBES GROWING INSIDE. WHAT MIGHT EXPLAIN THESE RESULTS.

11%	A. THE MICROBES FELL FROM THE AIR INTO BOTTLE 2.
2%	B. THE MICROBES ESCAPED FROM BOTTLE 1.
55%	C. THE AGAR IN BOTTLE 2 WAS NOT BOILED.
37%	D. A MICROBE FIGHTER WAS PUT IN BOTTLE 1.

MARK AN X ON YOUR CHOICES.

Assessment 2 asks students for possible explanations of why one flask has microbes and the other does not. Both correct choices were selected by 26 percent of the students, and 40 percent more selected at least one correct choice. The staff established the standards that 50 percent of the students should select one correct choice and 25 percent should select both choices. Student performance exceeded both standards.

Assessment 3 is a rating activity to determine how well students can make a poster on one of two themes, "How to Control Microbes" or "Places That Microbes Live." At least three microbe controllers or microbe habitats were included by 80 percent of the students. The staff-established acceptable standard was for 75 percent of the students to include at least three microbe controllers or habitats.

Many of the activities relating to this subtest had major revision or were dropped. This was done in accordance with a shift in emphasis from theoretical inquiry to more practical application about microbe fighters and microbe habitats. Two prime reasons for the emphasis shift were difficulties in developing meaningful controlled experimental laboratory conditions and further attempts to make the activities more relevant in terms of helping the students solve their own

persistant life problems. It is interesting to note that with the EMH students in this project, when laboratory results were clear and differentiated compared to less dramatic results, student learning and retention were extremely high.

Unit 2, Subtest 2, "Pictures and Drawings of Microbes"

Table 12 contains a statistical summary of two assessment items used as Subtest 2, "Microbe Pictures and Drawings." These assessments were administered as Activity 2-3 and Worksheet 2-1 in Core A, Unit 2, of the experimental editions. Table 12 includes item assessment objectives, item scoring, and other subtest statistics. The maximum score for this subtest was ten points, five points for each assessment.

TABLE 12
Summary Information for Subtest 2
"Microbes—Pictures and Drawings"
(two items)

This group of items assessed ability to:
- take pictures of microbe colonies (Item 1)
- draw accurately microbe colonies (Item 2)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G
1	0	5	0	0	0	0	0
2	0	5	-	-	-	0	0

Subtest Statistics:
Maximum Possible Score: **10**
Range of Scores: **0-10**
Number of Students: **271**
Mean: **7.65**

Assessment 1 measures student ability to photograph (Polaroid) a colony of microbes grown in class. Students were evaluated as successful if their pictures were in focus, adequately exposed, and centered well. The staff standard of acceptability was 66 percent, with 90 percent of the students successful. In a similar picture-taking activity in Field Test II, Unit 1, 84 percent of the students were successful. See Unit 1, Subtest 6 for further details relating to camera use.

Assessment 2 measures student ability to draw pictures of their microbe colonies, noting shape, size, color, and pattern growth. Compared to a 66 percent standard of acceptability on this activity, 74 percent of the students performed successfully.

Taking into account that many of these students had manipulative motor difficulties as well as poor eye-hand coordination, the results were remarkable. As a result of the students' performances, this type of activity was expanded; additional apparatus, such as a microscope and stereo glasses, was added to the equipment list for the commercial edition.

Unit 2, Subtest 3, "Microbe Fighters and Venereal Disease"

Table 13 contains a statistical summary of five assessment items used as Subtest 3, "Microbe Fighters and Venereal Disease." These assessments were administered as Activities 2-11 and 2-14 on Tallysheet 2-5 and Worksheet 2-6 in Core B, Unit 2, of both experimental editions 1971-72 and 1972-73. Table 13 includes item assessment objectives, item scoring, and other subtest objectives. The maximum score for this subtest was twenty-four points for assessment 5.

TABLE 13
Summary Information for Subtest 3
"Microbe Fighters and Venereal Disease"
(five items)

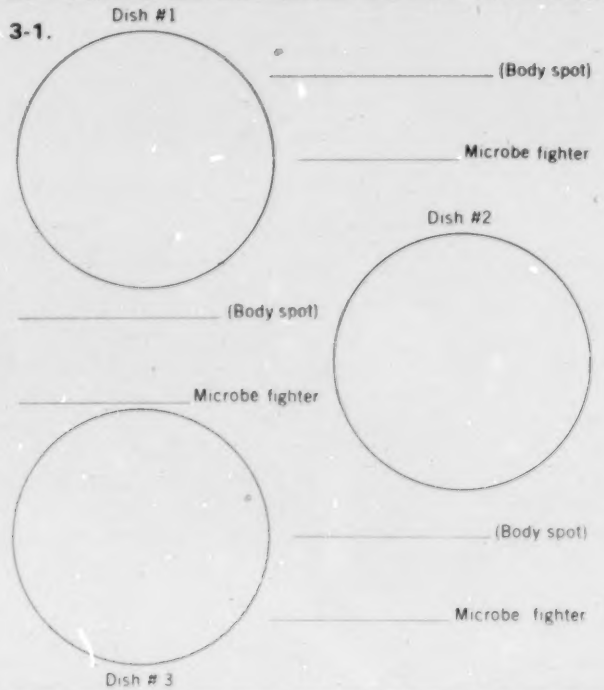
This group of items assessed:
- ability to collect and record data (Item 1)
- ability to discern the degree of effectiveness of different microbe fighters (Item 2)
- knowledge about what to do for treatment of venereal disease (Item 3)
- knowledge about which materials are microbe fighters (Item 4)
- knowledge about facts concerning venereal disease (Item 5)

Subtest Weighted Scores:
Weights Per Option

Item	A	B	C	D	E	F	G	H
1	5	0	-	-	-	0	-	-
2	5	3	0	0	-	0	0	-
3	0	5	0	0	-	0	0	0
4	1	1	1	1	0	1	0	0
5	0	1	1	1	0	0	0	1

Subtest Statistics:
Maximum Possible Score: **24**
Range of Scores: **0-24**
Number of Students: **253**
Mean: **14.2**

Assessment 1 is concerned with whether or not students could collect and record their own data, comparing soap and water to other microbe fighters. Results indicated that 76 percent of the students were successful without teacher assistance. The remaining 24 percent required teacher help. The project staff standard of acceptable student performance was 75 percent. Student performance met this standard.



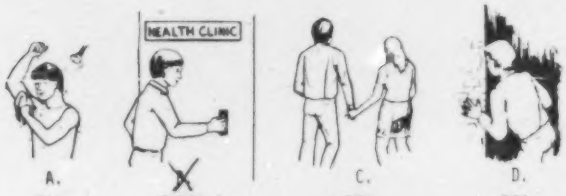
Assessment 2, a task activity, measures student ability to compare soap and water with a commercial microbe fighter and determine which one is more effective in reducing a microbe colony. Students were assessed on their ability to

discern. The data reveals that 78 percent of the students were accurate in their judgments, 16 percent had difficulty, and 6 percent were unable to make a decision. The staff determined that as a minimum 50 percent of the students should be accurate in their judgments and a total of 75 percent should be accurate or have only minor difficulty. Student performance exceeded these standards.

Assessment 3 shows scenes of four actions and asks students which action they should take if they think they have venereal disease. Results show that 96 percent of the students were successful in their response. The standard of acceptability for this question was 80 percent. Student performance exceeded the standard.

3-3. WHAT SHOULD YOU DO IF YOU THINK YOU HAVE VD?

MARK AN X ON THE ONE YOU CHOOSE.

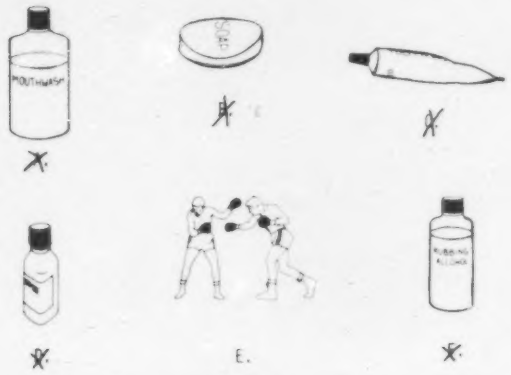


4% 96% 0% 0%

Assessment 4 shows six pictures and asks students to select the microbe fighters. All five of the fighters were selected by 47 percent of the students; 24 percent selected four of the five; 14 percent selected three; 8 percent selected two; and 5 percent marked only one. The standard of acceptability was for 80 percent of the students to mark three or more. Student performance exceeded this standard, with 85 percent scoring three or more.

3-4. WHICH ITEMS BELOW HELP YOU FIGHT MICROBES?

MARK AN X ON THE ONES YOU CHOOSE.



Assessment 5 lists eight statements about venereal disease and asks the students to check whether they agree or disagree with each statement. All four correct responses were selected by 44 percent of the students; 33 percent selected three out of four; 9 percent selected two; and 5 percent selected only one correct response. The staff had determined that 66 percent of the students should select three or more correct statements. Student performance exceeded this standard by 11 percent.

3-5. DO YOU AGREE OR DISAGREE WITH THE FOLLOWING STATEMENTS:

	AGREE	DISAGREE	
A.	X		VD CAN BE CURED.
B.		X	YOU CAN GET VD FROM TOILET SEATS.
C.		X	VD IS AGAINST THE LAW.
D.		X	YOU GET VD FROM SICK DOGS.
E.	X		VD IS CAUSED BY CERTAIN KINDS OF MICROBES.
F.	X		YOU CAN GET VD ONLY FROM SOMEONE WHO HAS IT.
G.	X		YOU CAN GET VD FROM SEXUAL INTERCOURSE.
H.		X	YOU SHOULDN'T TELL ANYONE IF YOU HAVE VD.

Student performance and teacher-student feedback on this subtest was good and therefore only minor revision and rearrangement took place in these activities in preparation for the commercial edition. The student success was attributed to the inherent interest value of personal hygiene and sex education. The materials include a concise, frank venereal disease booklet that students take home to discuss with their families.

Most of the revision that took place was an expansion and redrafting of the worksheets to make them more clear to students. Some parts of the activities that included food spoilage were moved to Unit 4, "Transfer and Cycling of Materials in My Environment," which deals with recycling. Some activities concerning microbes were dropped because it was believed they were inappropriate and often required a more sophisticated presentation than the curriculum developers felt appropriate for this student population.

Unit 2, Subtest 4, "Poster on Drugs"

This one assessment subtest was administered as Activity 2-19 on Tallysheet 2-7 in Core C, Unit 2, both experimental editions 1971-72 and 1972-73. Students were evaluated on their ability to construct a poster concerning a theme that would discourage friends from misusing drugs. Of the students, 90 percent constructed a poster and 85 percent selected a theme and related their poster to that theme. The staff had determined that 80 percent of the students should be able to construct a poster and 66 percent should be able to select an appropriate theme and relate their poster to that theme. Student performance exceeded these standards. For additional poster construction comparisons, see assessment 3 of Unit 1, Subtest 1, "Environmental Comparisons."

Student interest and performance was so high in activities related to this subtest that they were expanded in the commercial edition to include alcohol as a drug and the slide presentation in Activity 2-18 was converted to a filmstrip and booklet entitled, "Drugs: Use and Misuse."

Throughout Unit 2, Piagetian cognitive development tasks were added to the "Clues to Success" activities in the commercial edition to be used as baseline data for comparing student performance in Unit 2 to performance in the previous as well as later units. ■

the case history of a revision technique

The question is often asked, "How is a new and different idea tested before it's included in a curriculum?" An educated intuition and a knowledge of the population based on past experience and research serves as an initial input. Often that is all there is to go on prior to the field test, when materials are still in the formative stage. Sometimes, however, the idea is so unusual that there is no comparable precedent for it. Then a small-scale pilot test is in order, even prior to large-scale field-testing. Those who participate in a large-scale field test do so with the realization that the materials are less than perfect. Even so, every attempt should be made by the developers to anticipate and solve problems before they occur. Thus a small-scale field test using just one class or several typical students often proves valuable.

A case in point involved the inclusion of certain activities in the commercial edition of Unit 2, "Me as an Environment," where EMH students use a pair of "stereoglasses" in viewing a set of paired pictures taken with a stereoscopic camera. Though the use of stereograms and viewers had been tested successfully with normal high school biology students, to our knowledge they had never been introduced as part of the curriculum for junior high school EMH students. Yet the medium was believed to be an ideal vehicle for reintroducing the students to techniques of observation, description, and comparing, as well as the ordering of objects in a picture from closest to farthest. This is similar to a filmstrip activity, "Zoom In..., Zoom Out," used in the last portion of Unit 1, "Exploring My Environment."

In the usual sequence of teaching, Unit 2 follows Unit 1, with a summer break in between. Because of the break, a recapitulation of major ideas and techniques was believed to be in order before students embark upon the new unit. It was also believed desirable that built-in redundancy of ideas be incorporated, utilizing a different medium in order to avoid mere repetition.

As a baseline from which to judge the EMH class undergoing the small-scale field test, data was used that had been collected from normal biology classes where the new BSCS stereogram program was being tested. The BSCS consultant directing that program accompanied the EMH project director.

What follows is a summary of the visit to a local class.

Purpose:

To determine whether this class of EMH students could use a pair of "stereoglasses" in viewing a set of paired pictures.

Criteria of success:

1. Statements given by the students that indicated the pictures viewed appeared to be in three dimensions.
2. Student enthusiasm over the task as indicated by actions in class and requests to take the pictures and glasses home to show their families.
3. Student on-task behavior.
4. Subjective comparison of this EMH class with "normal" classes in the ease or difficulty of bringing the picture into focus, in enthusiasm, and in on-task behavior.

Setting:

The "science classroom" for this class.

Choice of material:

The card set "Unseen Life," a part of the BSCS experimental stereogram program, *Biology in Three Dimensions,* was used for the following reasons:

1. Of all the sets in the program it allowed for the least amount of structure in use.
2. It could be related to the material being studied by the class, and equipment already set up in the classroom could be used.
3. It related most closely to the subject matter that would most likely be used in the commercial edition of Unit 2.
4. It lent itself to the greatest amount of aesthetic appreciation among the students.
5. It was the easiest of all the sets in the program for EMH students to understand.

Context within which the activity was used:

The two observers introduced themselves and asked the students to introduce themselves to the observers. The observers made reference to the filtration plant set-up in the room, asked the youngsters what it was, how it worked, and what they found out from its use. To the student response that "It [the plant] cleared up water of mud and things we couldn't see," the observers stated that some of these things too small to see were similar to those pictured in the card set.

Introduction:

Pairs of students (there were fourteen students present) were handed a set of the cards and asked to look at them and ask any questions or make any observations they wanted to. Within a couple of minutes many had asked, "Why are two pictures of the same thing next to each other?" To find the answer to this question, the students were asked to hold pencils at eye level in front of them and to cover one eye with the free hand. Then, without moving the pencil, to open the eye and close and cover the other eye. "What did you notice?" Most gave an answer to the effect that "It [the pencil] moved." Look at it with both eyes open. "It wasn't flat." The idea of stereo vision was discussed, and how two pictures viewed through stereoglasses could "fuse."

Use:

The students were asked to take the glasses out of the cases and to use them (look through them) in any way they wanted. After a couple of minutes, they were asked to tell what they noticed.

Examples of statements made by the students:

1. They act as a magnifying glass.
2. They have two lenses (sides, eye pieces).
3. They can be moved together or apart.
4. They can stand up (in reference to the metal frames).
5. They can be moved so the two pictures become one.

Instruction was then given on how to place each lens over more or less the same spot of each of the two pictures and move them together or apart as one would a pair of binoculars. From this point on the observers were sure that within ten minutes all but two of the students were able to use the glasses. The students then looked at a stereogram of the spores on a bread mold. Statements made by individual students to the observers and to the teacher as they circulated among them were:

1. "They are floating off the paper."
2. "It looks like I could pick them up."
3. "They look like little donuts that I could stick my finger through."
4. "They look more real."
5. "There are things sticking up at me."
6. "Some things are closer than others."
7. "It looks like 3-D."
8. "Now it looks like a wheat (grain)."
9. "Hey, there really is only one."
10. "You're right, it really does."
11. "Wow, that's neat."
12. "All of a sudden it jumped up at me."

Enthusiasm:

Excitement and enthusiasm were expressed by all. One student had a broken glass and two tears rolled down his cheeks. He was noticeably relieved and happy when given a new glass. The little girl with an extreme speech impediment showed interest but no enthusiasm until she asked if she could take the cards and glasses home to show her family.

The class as a whole seemed to show more enthusiasm than the normal classes. The youngsters as a whole seemed to manage the use of the glasses more rapidly than did those in the normal classes.

Three of the youngsters wanted to take a set of glasses and cards home that night. This was somewhat disappointing until all but one said they wanted to wait until the next night, Friday, so they could keep them all weekend.

Conclusion:

It is acknowledged that the sample size was small, and that there is possible influence of the halo effect. The above experience would tend to indicate that typical EMH youngsters have no more difficulty in using stereoglasses and cards than those in normal classes and show as much enthusiasm as do others. Because this medium provides still another form of variety in instruction, and in fact is the most efficient and suitable way of presenting certain materials, besides its relatively modest cost ($1.95 per pair of glasses and about 10¢ per card), it can be a positive attribute to ME AND MY ENVIRONMENT. It will be used in two activities near the beginning and one in the middle of the commercial edition of Unit 2. It will be used in subsequent units as the opportunity presents itself. ■

a survey of EMH students on smoking, drinking, and drugs

Using tobacco, alcohol, and unprescribed drugs is a major part of the subject matter in Unit 2 of ME AND MY ENVIRONMENT. The placement of this material in that particular sequence of the curriculum was a tentative choice, to be tested later in order to determine, if possible, how relevant such material is to the 13-year-old EMH students for whom it is primarily intended.

Late in 1972, during the first field test (FT I) of ME AND MY ENVIRONMENT, the questionnaire shown here was sent out to test classes for administration to the students before beginning their work on Unit 2. The same questionnaire was administered after the students completed the unit. In the second field test (FT II), the same procedure was followed.

DO NOT WRITE YOUR NAME ON THIS

QUESTIONNAIRE ABOUT SMOKING, DRINKING, AND DRUGS

DIRECTIONS:

PLEASE ANSWER EACH QUESTION HONESTLY. NO ONE WILL FIND OUT HOW YOU ANSWERED. CIRCLE THE ANSWER YOU CHOOSE FOR EACH QUESTION.

1. SHOULD PEOPLE YOUR AGE SMOKE TOBACCO? (CIGARETTES, CIGARS, PIPES)	YES	NO
2. SHOULD PEOPLE YOUR AGE DRINK ALCOHOLIC BEVERAGES? (BEER, WINE, LIQUOR)	YES	NO
3. SHOULD PEOPLE YOUR AGE USE DRUGS NOT PRESCRIBED BY A DOCTOR? (MARIJUANA OR GRASS, HEROIN OR HORSE, LSD, PEP PILLS, OR OTHER DRUGS)	YES	NO
4. DO ANY OF YOUR FRIENDS SMOKE TOBACCO?	NO	SOMETIMES OFTEN
5. DO ANY OF YOUR FRIENDS DRINK ALCOHOLIC BEVERAGES?	NO	SOMETIMES OFTEN
6. DO ANY OF YOUR FRIENDS USE DRUGS NOT PRESCRIBED BY A DOCTOR?	NO	SOMETIMES OFTEN
7. DO YOU SMOKE TOBACCO?	NO	SOMETIMES OFTEN
8. DO YOU DRINK ALCOHOLIC BEVERAGES?	NO	SOMETIMES OFTEN
9. DO YOU USE DRUGS NOT PRESCRIBED BY A DOCTOR?	NO	SOMETIMES OFTEN

A summary of the students' answers to the questionnaire was prepared for the information of the staff, program developers, and advisory committee members. The following excerpts from one pretest summary are presented here in the belief that the extent to which alcohol, drugs, and tobacco are used among this sampling of 13- to 16-year-olds is of general interest. The attitudes of these students toward the use of alcohol, drugs, and tobacco did not change significantly after their introduction to Unit 2 of ME AND MY ENVIRONMENT. Data supporting this conclusion is available to anyone who might be interested, but is not included here because of space limitations.

A summary of student answers to the questionnaire about smoking, drinking, and drugs

Field Test II: Pretest

A questionnaire about smoking, drinking, and drugs was administered to 13- to 16-year-old EMH students to obtain information about the population regarding their attitudes and contact with smoking, drinking, and drugs. In addition, it was used to determine the appropriateness and direction of the ME AND MY ENVIRONMENT curriculum, which includes those topics in its content. The same questions were asked as a posttest to determine whether student responses change after instruction.

The questions were arranged in order of least to most personal and potentially threatening to students. The first three questions ask students to respond "yes" or "no" to whether people their age should smoke tobacco, drink alcoholic beverages, and use drugs not prescribed by a doctor. The second three questions (4-6) ask the students to rate their friends on the same three topics, using a scale of never, sometimes, often. The final three questions (7-9), which students would probably feel most threatened to respond honestly to, deal with whether or not they personally indulge in any of the three, on a scale of never, sometimes, often.

Responses to the questionnaire were received from 235 students in 17 classes participating in their initial year of field-testing ME AND MY ENVIRONMENT (FT II). The analysis includes a breakdown by class based on the ages of most of the students in the class; mostly under age 13, mostly age 13, or mostly over age 13.

The analysis of the results of this pretest deals with a brief discussion of the results and tentative conclusions:

I. Should people your age
   (1) smoke tobacco
   (2) drink alcoholic beverages
   (3) use drugs not prescribed by a doctor?

Most of the students in all classes responded that people their age should not smoke tobacco (90%), should not drink alcoholic beverages (84%), and should not use unprescribed drugs (96%).

This data indicates that students generally realize that smoking, drinking, and drugs are not appropriate for people their age. However, the number of students who feel that alcohol IS appropriate for people their age is noticeably higher than for smoking and drugs (refer to Table 14). Unfortunately the context of alcohol usage was not obtained in the questionnaire (i.e., at home, at parties, in the local establishments).

These figures are highly comparable with results from Field Test I; there is very little difference, as shown in Table 14.

A comparison of negative responses by percent between Field Test I and Field Test II is shown in Table 14 for the first three items of the pretest questionnaire.

TABLE 14 Negative (no) Responses (by %) for Students on Pretest Items 1-3, FT I and FT II

People Your Age:	FT I	FT II
(1) Tobacco	87	90
(2) Alcohol	84	84
(3) Drugs	94	96

II. Do any of your friends
(4) smoke tobacco
(5) drink alcoholic beverages
(6) use drugs not prescribed by a doctor?

Responses show a large discrepancy between what students believe "people their age" should do and what "their friends" do (refer to Table 15). Fifty-three percent reported that their friends SMOKE TOBACCO "sometimes" or "often" in contrast with 90 percent who thought people their age should NOT smoke. Forty-four percent reported that their friends DRINK ALCOHOL "sometimes" or "often" in contrast with 84 percent who thought people their age should NOT drink alcohol. Eighteen percent reported that their friends USE DRUGS "sometimes" or "often" in contrast with 96 percent who thought people their age should NOT use drugs.

These figures are highly comparable with results from Field Test I; there is very little difference between the groups, as shown in Table 15.

A comparison of negative (no) responses by percent between Field Test I and Field Test II is shown in Table 15 for items 4, 5, and 6 of the pretest questionnaire.

TABLE 15 Negative (no) Responses (by %) for Students on Pretest Items 4-6, FT I and FT II

Your Friends:	FT I	FT II
(4) Tobacco	51	45
(5) Alcohol	55	54
(6) Drugs	79	81

III. Do you
(7) smoke tobacco
(8) drink alcoholic beverages
(9) use drugs not prescribed by a doctor?

The greatest discrepancies in ratings occurred on the TOBACCO items in all three categories of questions: 90 percent believed people their age should not use tobacco, 45 percent reported that their friends do not use tobacco, and 73 percent reported that they do not use tobacco themselves.

These figures indicate a rather important difference between what the students say they believe and what they practice, since less than 10 percent believe students their age should smoke while 27 percent report that they, in fact, do smoke. This figure (27%) may be conservative if students were reluctant to trust the anonymity of their responses; this is further substantiated by the much higher number of students who report that some of their friend(s) smoke (53% total). Furthermore, of their friend(s) who smoke, 24 percent report that these friend(s) smoke "often."

A comparison of negative (no) responses by percent between Field Test I and Field Test II is shown in Table 16 for items 7, 8, and 9 of the pretest questionnaire. These figures show little difference between the two field-test groups and further substantiate the results of the sample of students in FT I.

TABLE 16 Negative (no) Responses (by %) for Students on Pretest Items 7-9, FT I and FT II

You:	FT I	FT II
(7) Tobacco	74	73
(8) Alcohol	71	70
(9) Drugs	90	93

Responses to the smoking item in relation to self tend to be somewhat surprising. Only 84 percent of the students UNDER THE AGE OF 13 responded "no," they do not smoke; 10 percent (7 out of 61) responded that they smoke "sometimes," while an additional 6 percent (5 out of 61) responded that they smoke "often." Figures for classes in which students were PREDOMINATELY 13 and classes in which students were mostly OVER THE AGE OF 13 were essentially similar to each other, but GROSSLY DIFFERED from the "under 13" classes (refer to Table 17). Thirty-two percent of the "mostly 13" classes smoke "sometimes" or "often"; 30 percent of the "over 13" classes smoke "sometimes" or "often."

TABLE 17 Tobacco Responses for 3 Age Groups (Item 7), FT II

	N	No	Sometimes	Often	NR
		%	%	%	%
Under 13 Years	73	84	10	6	0
Mostly 13 Years	111	68	27	5	1
Over 13 Years	51	69	14	16	1

These responses suggest the difficulty of deciding when to teach information regarding decision-making for smoking. If the subject of smoking is taught at too young an age, students may not be interested or ready to deal with the information. If it is taught too late in the curriculum when students are older, it loses its value for the decision-making process. The data from this item suggests that the "mostly 13 years" group is the most appropriate age, particularly from looking at the trend in the "often" category from "mostly 13 years" (5%) to "over 13 years" (16%). While the actual number of students in those categories is small and the percentages are not significantly different, the trend from smoking "sometimes" to smoking "often" (refer to Table 17) must nevertheless be given some import. It is easier for people who have just begun smoking or who smoke only occasionally to quit than it is for those who smoke often or who have established the habit.

Since the activities on smoking remained in Unit 2 they will occur in the first half of the 8th grade (assuming units are initiated in the 7th grade and taught in sequence). Based on the results of this questionnaire and on the assumption that most students are 13 in the first half of the year, this set of activities was retained in Unit 2.

A breakdown of figures by age level is not particularly revealing for alcoholic beverages or drugs. There is no apparent trend in greater usage as students grow older (refer to Tables 18 and 19).

With alcoholic beverages, about 70 percent of the students reported no usage, while about 25 percent report drinking "sometimes" and 5 percent report drinking "often." These figures are fairly consistent across all three age groups as indicated in Table 18. Again, a shortcoming of the questionnaire is that the context for drinking is not disclosed (e.g., in the home, at parties, in establishments, etc.).

This data suggests that the students are probably interested and ready to learn information concerning alcoholic beverages at any of the age levels for which the curriculum is designed.

TABLE 18 Alcohol Responses for 3 Age Groups (Item 8), FT II

	N	Often	Sometimes	No	NR
		%	%	%	%
Under 13 Years	73	3	25	71	0
Mostly 13 Years	111	6	20	70	3
Over 13 Years	51	4	28	65	2

Since it was felt that some students would rate their friends more honestly than themselves (a cautious and self-protective measure), an analysis of ratings of friends by age category was made and subsequently compared with self-ratings (refer to Table 19). It was assumed that, no matter what the age of their friends, students who are aware that their friends drink need to be informed about the use of alcohol, since they are likely to be confronted with a decision about drinking.

The analysis showed that one-third of the students 13 years old or less have friends who drink at least sometimes. For classes containing most students over age 13, over one-half of the students reported having friends who drink alcoholic beverages at least sometimes (refer to Table 19).

Therefore, while few students at any age drink "often" or have friends who drink "often," the increase of friends who drink "sometimes" for students over age 13 (about a 17% increase) suggests that the content is most timely *before* the majority of students in a class are over 13.

TABLE 19 Comparison of Alcohol Responses (by %) Between Your Friends (Item 5) and You (Item 8)

	N	No (%)		Sometimes (%)		Often (%)		NR (%)	
		Friends	You	Friends	You	Friends	You	Friends	You
Under 13	73	60	71	32	25	7	3	1	0
Mostly 13	111	56	70	35	20	8	6	1	3
Over 13	51	41	65	51	28	6	4	1	2

With drugs, almost all students reported no usage. An increase in taking drugs was reported in the "sometimes" category by students 13 years and older (refer to Table 20), but the increase was slight and does not show a trend.

TABLE 20 Drug Responses for 3 Age Groups (Item 9), FT II

	N	No %	Sometimes %	Often %	NR %
Under 13 Years	73	97	1	1	0
Mostly 13 Years	111	89	11	1	1
Over 13 Years	51	92	6	0	0

The analysis was continued to include a breakdown by age categories (refer to Table 21) comparing ratings of friends with self-ratings of drug usage. While the analysis did not reveal great differences from one age group to another, the most surprising figures occurred in the mostly age 13 group. Fully 15 percent reported that their friends use drugs "sometimes"; an additional 6 percent reported that their friends use drugs "often." About one-fifth of the students have friends using drugs compared with less than one-tenth who admit using drugs themselves. Many students have contact with people using some type of unprescribed drugs (caution: perhaps this means aspirin to some students) and consequently have drugs available to them from this source.

TABLE 21 Comparison of Drug Responses (by %) Between Your Friends (Item 6) and You (Item 9)

	N	No (%)		Sometimes (%)		Often (%)		NR (%)	
		Friends	You	Friends	You	Friends	You	Friends	You
Under 13	73	85	97	9	1	4	1	1	0
Mostly 13	111	77	89	15	11	6	1	1	1
Over 13	51	84	92	8	6	8	0	0	0

The foregoing analysis suggests few clues as to the best age at which students should be taught about drugs. The highest concentration of students using drugs in this sample occurred in the mostly age 13 category, so perhaps drug information should be taught prior to but no later than this age.

Additional Discussion

Besides a general system of age grouping, classes have been categorized for field-test purposes as mainly urban, suburban, or rural. A pattern of greater or lesser usage was not established, nor were any characteristic differences determined relative to these types of settings (i.e., urban, suburban, rural).

Summary and Conclusions

1. Results from Field Test II further validate those of Field Test I.
2. Most students reported that people their age should not smoke, drink alcoholic beverages, or use drugs not prescribed by a doctor.
3. About one-half of the students reported having friends who use tobacco and alcohol; about one-fifth reported having friends who use drugs.
4. About one-fourth of the students self-reported the use of tobacco and alcohol; less than one-tenth self-reported the use of drugs.
5. About one-third of the students in classes composed mostly of students 13 years and older self-reported that they smoke. The trend toward smoking "often" over age 13 suggests that students be instructed prior to then regarding smoking. The highest interest level would probably be in classes containing mostly 13-year-olds.
6. Since over half of the students in classes of over 13 have social contact with friends who use alcoholic beverages, students may need information regarding alcohol before reaching that age so they can make decisions when confronted by friends.
7. Although most students do not use unprescribed drugs, 15-20 percent reported having friends who do. These results suggest that drugs be taught in the curriculum; the evidence is not clear-cut about the best age in students' lives for them to be taught about drugs, but suggests prior to the "mostly age 13" classes. ■

Originally an entire report on this topic was planned. It has been decided, however, to transmit the information through various journals and presentations of papers at relevant meetings. Abstracts of four such papers are presented below.

functional abilities of students

Of major interest to the curriculum development staff of ME AND MY ENVIRONMENT is that group of evaluation questions closely related to the functional abilities of the student population. (See pages 14-26 of *Formative Evaluation Report 2*.) Two questions of most direct utility are:

- What are appropriate and realistic educational expectations for educable mentally handicapped children, where the American Association on Mental Deficiency standard identifies their handicap as mild?
- What is the value and relevance of the various means used in identifying and grouping EMH children?

Extensive, but preliminary, studies have been undertaken at the BSCS, and several publications related to this issue have been written utilizing data obtained during the formative evaluation of ME AND MY ENVIRONMENT. It would be redundant to repeat the data and findings here. Because of their potential significance, however, four abstracts of these studies are included.

Gray, William M. 1975. The integrated cognitive structures of EMH (Educable Mentally Handicapped) children. In G. I. Lubin, J. F. Magary, and M. K. Poulsen (Eds.), *Piagetian theory and the helping professions*. Los Angeles: University of Southern California.

Attempts to measure certain concepts central to Piaget's theory of cognitive development—namely, the sequence in the development of cognitive structures and their identity as a structured whole—have raised two questions: First, can the two concepts be measured at all, and if so, what is the appropriate measurement model? And second, are the two concepts exhibited in atypical (in this case, EMH) populations? Three hundred seventy-five 13- to 16-year-old EMH students were given the Cognitive Development/Problem Solving Tests (CD/PS) developed by the BSCS in 1972-74 during the formative evaluation of ME AND MY ENVIRONMENT. Most of the twenty-item written test, which was composed of twelve cognitive-development and eight problem-solving items, was a derivation of questions used in a previous study by Gray (W. M. Gray. 1970. Children's performance on logically equivalent Piagetian tasks and written tasks. *Educational Research Monographs*. Dayton: University of Dayton. Doctoral dissertation, SUNY at Albany, 1970. *Dissertation Abstracts International*, 1970, 31, 2736A. University Microfilms No. 70-23, 450.) Sequence and structured whole were evident in measurable form, and an appropriate measurement model was found to be one that stresses logical prerequisites. In addition the cognitive structures of atypical subjects [EMH students] do exhibit the characteristic of sequence and structured whole.

Gray, William M. 1975. An integration of Piaget and criterion-referenced measurement. Paper presented at the annual meeting of the American Educational Research Association. Washington, D. C., April.

Piaget's theory and criterion-referenced measurement (CRM) are presented and examined. The relationship between the two are examined in the following areas: age assignment of items; item selection and difficulty; subject variance; cognitive structures and an achievement continuum; content and performance; reasoning behind a response; and performance to be assessed and performance criteria. CRM holds promise of alleviating some of the deficient practices utilized in present-day testing; Piagetian theory delineates an approach to assessing the mental processes in a way other than the behavioristic approach. It is concluded that Piaget's behavior-referenced system would be an ideal psychological basis for

the construction of criterion-referenced measurement.

Steele, Joe M. 1974. The relationship of developmental level with science performance: a case for an alternative to IQ grouping of mildly retarded children? Paper presented at the annual meeting of the American Educational Research Association. Chicago, Illinois, April.

The question under consideration in this paper is whether it is feasible to place children into special classes on the basis of IQ scores. An alternative cognitive developmental method based on Piaget's developmental model was investigated. A total of 492 educable mentally retarded (EMR) students, 12-15 years old, participated in two field tests (1971-1973) of the ME AND MY ENVIRONMENT program developed by the Biological Sciences Curriculum Study. The BSCS project staff developed three instruments that were used in the study. They include: Cognitive Development/Problem Solving (CD/PS) Tests of Developmental Level, Teacher Ratings of Students, and Student Performance Measures for Units 1, 2, and 4. The data was analyzed by using twenty-eight regression analyses involving seventeen variables, such as the student performance measure, the four CD/PS subtests, six teacher ratings, test class data, and demographic variables. Results confirmed the hypothesis that levels of cognitive development may be measured without IQ scores, and that children's IQ, age, ethnic background, and sex did not count for significant variance over seven replications. Implications of the study included the suggestion for further exploration of strategies, such as cognitive development grouping for more effective instruction. (A lengthy appendix of tables and statistical data is included in the article.)

Steele, Joe M. 1975. A longitudinal and comparative look at cognitive development in EMH children. Paper presented at the annual meeting of the American Educational Research Association. Washington, D. C., March.

A case for using the Piagetian model of cognitive development in determining placement and curriculum of EMH children was investigated during a field test of the ME AND MY ENVIRONMENT program, a three-year environmental sciences program developed by the Biological Sciences Curriculum Study. The dimensions of rate of cognitive development and proportion of cognitive development at each level were explored in a sample of 202 EMH children 13-16 years old by using the BSCS Cognitive Development/Problem Solving (CD/PS) Tests. Each item in the instrument was weighted according to its developmental level, with the formal operational level items receiving more weight in points than the concrete operational level items. The resulting proportions were then compared to the proportions of cognitive developmental levels for 11- to 13-year-old children in regular classes. Then the students were classified at four levels of cognitive performance according to the number of points achieved on the instrument. Results showed that during a twelve-month period, over half showed no change in developmental level, while those who made changes did not gain more than one level. A high positive relationship was found between cognitive level and performance, while it was shown that IQ, age, and ethnic background accounted for *none* of the variances in performance. Implications included changing educational placement and instructional pedagogies to include the developmental model to accommodate each child's level of understanding, rather than continuing to place and teach children in the traditional information-transmission model. (Tables of statistical data and an appendix of test examples are included in the paper.) ■

summary and implications in brief

Three general types of assumptions continue to be reinforced during the course of the evaluation of the revised curriculum of Units 1, 2, and 3. First, the value of formative evaluation (i.e., the systematic assessment of each step during the curriculum development process to determine the particular effectiveness of content, strategies, format, and media, and the maintenance of that feedback necessary to the revision and refinement of curriculum) continues to be demonstrated when measured in terms of specific student behavioral and cognitive performance objectives. Examination of Figures *1*, *3*, and *4* shows that of the twenty identical or very similar content assessments directed towards specific objectives, seventeen showed a mean increase of 28 percent more students answering or performing a task satisfactorily. Some of this gain can be attributed to the refinement of those assessments that were changed, but most is probably due to revisions in strategies, media, or sequence based upon the formative evaluation. A potentially interesting summative study would involve taking all three versions of a given unit in ME AND MY ENVIRONMENT and, under controlled conditions, determine the effect each of the revisions had on the students' grasp of the objectives called for.

The second implication, and one that does require continuing study, is that related to the cognitive development of EMH children and its influence not only on what the student can be expected to learn, but on when various types of problem-solving and inquiry skills can be realistically called for. The use of IQ as a primary predictor of student success in this particular curriculum can be seriously questioned, as has been discussed in Report 2. This entire issue has been elaborated upon in the four papers abstracted in the previous section.

Finally, there are several specific comments that should be made relating to student performance. On several of the subtests of Units 1, 2, and 3, student performance significantly exceeded and in other cases was significantly below BSCS staff expectations. It is believed that a brief discussion of these results may offer generalizable implications for other developers of materials for EMH students.

With an awareness that many EMH students have weak manipulative motor skills, as well as poor eye and hand coordination, the BSCS staff had low expectations for student success in those activities requiring such skills. Student performance was exceptional on the most demanding of those activities, however, and in some cases exceeded the performance of normal students of comparable age. Slightly over 89 percent of the students successfully handled a thermometer and accurately recorded temperatures, in a variety of environments, within ± 2°F. Over 84 percent of the students were successful in manipulating a Polaroid camera and in taking good pictures, which were evaluated for focus, exposure, positioning, and steadiness. Nearly all of the students were successful in manipulating microscopes, stereoglasses, and triple-beam balances.

One logically asks why students performed manipulative activities more successfully in this curriculum than they had in previous experiences. Could it be the approach? First, the teacher demonstrated; then, small groups performed the activity; and finally, the individual tried it alone. We are not sure why this seemed to work, but the results indicate that EMH students can learn rather complicated, manipulative skills and perform them well. That most certainly suggests further research for those in the field of special education.

Another area of surprising student performance was in graphing. EMH students successfully accomplished drawing, labeling, recording, and even interpretation of graphs to a marked degree. Over 88 percent of the students successfully identified particular points on a graph and 86 percent entered new data. Over 80 percent entered all the data on labeled axes; nearly 70 percent did the whole graphing process, including labeling axes; and 60 percent successfully interpolated graph information. Prior to our field-testing, some curriculum consultants advised that these tasks were "un-do-able" by EMH students. Again, if this is generalizable, what an asset this information would be to other curriculum developers for special education. Since EMH students have difficulty with reading and writing, graphing could be an effective communication tool for them. In any event, the results warrant additional investigation.

Another student behavior that appeared again and again was the lack of ability to extend learning in directions opposite from those developed by the curricular materials. EMH students definitely appear to develop strong unidirectional patterns of learning. For example, in four different activities of Unit 3, concepts relating high temperature to high energy were developed. On the five items of Subtest 1, Unit 3, that assessed understanding of this concept, the average student performance was 86 percent successful. When students were assessed on an extension of this concept, however, namely the relationship of low temperature to low energy, less than 40 percent of them were successful. This type of response occurred four different times in as many subtests. If these results can be generalized, it appears that EMH students have low incidental learning and an inability to break sequence patterns. ■

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Me and My Environment

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